

The role of sociable computer game play in facilitating social support,
self-efficacy, and positive health-related behaviour change

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DECLARATION:

I declare that this thesis is entirely my own work carried out at Teesside University in the pursuit of the Degree of Doctor of Philosophy. No part of this work has been submitted for any other award or assessment at Teesside University or other institution. This thesis contains no information by another individual, except, where due acknowledgement is made and proper credit is given.

I know enough to know that I know nothing at all

- Socratic paradox -

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Abstract

The capacity for sociable computer game play to facilitate positive health-related behaviour change by promoting social support and self-efficacy was investigated. The behavioural outcomes under investigation across three intervention-based studies were increasing physical activity and reducing perceived stress.

According to Iwasaki and Mannell's hierarchical model of leisure stress coping a distinct motivation for leisure engagement is the pursuit of sociable interaction, and by extension, social support. This model was uniquely applied to provide a theoretical account of the potential for sociable computer game play to be facilitative of social support. Social support is predictive of self-efficacy and both are strongly associated with initiating and maintaining positive health-related behaviour. This research presents a unique arrangement of these constructs in a mediating relationship between social support, facilitated by sociable computer game play, and positive health-related behaviour that is mediated by self-efficacy.

Study 1 and 2 included a group study condition involving sociable computer game play, a solo study condition involving solo computer game play, and a control study condition with no computer game play. Computer game play (Wii Sports) occurred for 30 minute periods on a weekly basis for eight weeks. Analysis involved three-by-two (study condition by time point) mixed analysis of variance (mixed ANOVA) and analysis of covariance (ANCOVA), which were supplemented with magnitude-based inference (MBI). MBI used simple contrasts between the group and solo study conditions (mixed ANOVA and ANCOVA) and the solo and control study conditions (ANCOVA). Furthermore, mediation analysis was performed in which social support was the predictor, self-efficacy the mediator, and physical activity or perceived stress the outcome.

Mixed ANOVA and ANCOVA identified two instances of a significant difference between the group and solo study conditions. Such instances involved the frequency of physical activity being greater following sociable computer game play with ANCOVA in Study 1 and quantity of social support being greater following solo computer game play with ANCOVA in Study 2. Through MBI in Study 1, the intervention was inferred to be mechanistically likely positive for quantity of social support and satisfaction with social support, vigorous-intensity physical activity, total physical activity, and the frequency of physical activity, each of which had associated clinical inferences recommending use of the intervention. MBI in Study 2 revealed a most likely trivial mechanistic inference for social support satisfaction which had an associated clinical inference recommending use of the intervention. Mediation analysis identified indirect-only mediation to have occurred within both studies. In Study 1 indirect-only mediation was detected within the group study condition and in Study 2 in the group and solo study conditions.

Study 3 produced qualitative information following a top-down theoretical thematic analysis in which the assumptions made between the investigated psycho-social constructs and their association to sociable computer game play was supported. Findings from each study support sociable computer game play as an effective therapeutic tool for increasing engagement in and frequency of physical activity and reducing perceived stress. The research presented in this thesis represents a number of unique contributions to scientific knowledge, including the application of the hierarchical model of leisure stress coping within this context as well as evidence for the tested mediation model. Aspects of the study design in both investigations as well as the analytical techniques that were used appear to be novel within this area of health psychology.

Abbreviations, acronyms, and symbols

\pm	Plus / minus symbol
α	1. alpha; the probability of making a Type I error. 2. Cronbach's index of internal consistency
ANCOVA	Analysis of covariance
ANOVA	Analysis of variance
APA	American Psychological Association
b	Estimated values of unstandardised regression coefficient
BCa	Bias-corrected accelerated
BMI	Body mass index
BPS	British Psychological Society
CI	Confidence interval
CL	Confidence limits
d	Cohen's d ; measure of sample effect size
df	Degrees of freedom
DSM-5	Diagnostic and Statistical manual of Mental Disorders, 5 th Edition
ES	Effect size
F	F-ratio
F_{\max}	Hartley's test of homogeneity of variance
Freq	Frequency
GSES	General Self-Efficacy Scale
HIV/AIDS	Human immunodeficiency syndrome/Acquired immune deficiency syndrome
HPA	Hypothalamic-pituitary-adrenocortical axis
M	Mean
MBI	Magnitude-based inference

MMORPG	Massively multiplayer online role-playing game
Mod	Moderate-intensity (physical activity)
n	Number of cases in a subsample
N	Total number of cases
η^2	Eta squared; measure of strength of relationship
NHS	National Health Service
NHST	Null-hypothesis significance-testing
p	Significance value
PA	Physical activity
PROCESS	Macro for mediation, moderation, and conditional process analysis for SPSS/SAS
PSS	Perceived Stress Scale
PTSD	Post-traumatic stress disorder
r	Pearson's r correlation coefficient
R^2	r squared; coefficient of determination; measure of strength of relationship; estimate of the Pearson product-moment correlation squared
SAM	Sympathetic-adrenal-medullary system
SD	Standard deviation
SEEHS	Self-Efficacy and Exercise Habits Survey
SPSS	Statistical package for the Social Sciences
SSQ6	6-item Social Support Questionnaire
SSQN	Social Support Questionnaire number score
SSQS	Social support Questionnaire satisfaction score
t	t statistic
Vig	Vigorous-intensity (physical activity)
WHO	World Health Organization

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1.1. Overview

This chapter aims to provide general background and contextual information about the topics that are presented within this thesis. This includes a brief examination of negative health-related behaviours and why individuals may elect to engage in them, the role of psychology in modifying negative health-related behaviour to be positive health-related behaviour, the recent application of technological tools in behaviour modification, and consideration of the theoretical framework and aims of the research that is presented in this thesis. Following this, a description of the structure of the thesis is presented.

1.2. Health behaviour

There are many behaviours that are considered to be damaging to health, with supporting research evidence. Some examples of these behaviours could be an activity that is perceived to be relatively innocuous, such as a sporting pursuit or an activity that is more widely perceived to be dangerous such as smoking or drug consumption.

Depending upon the negative health-related behaviour in question, the effect of these behaviours upon health is wide-ranging, with relatively minor, incrementally dangerous, or serious life-endangering effects. A specific sporting activity such as American football, which has a higher likelihood of injury than other sports such as basketball and football (Carter, Westerman, & Hunting, 2011), could be considered to be deleterious to health even though, in general, physical activity is considered essential for good health (National Health Service [NHS], 2018a). On the other hand, the ingestion of recreational drugs is widely considered to be a negative health-related behaviour due to the associated outcomes of these activities, such

as addiction, disturbance to physiological and psychological wellbeing, and reduced relationship quality (Holloway, Benett, Parry, & Gorden, 2013). Despite this, individuals such as university students (Ansari et al., 2011) still elect to engage in substance abuse for recreational purposes and mood enhancement (Holloway et al., 2013).

Some examples of negative health-related behaviours and their specific associated outcomes on health include the regular consumption of sugary food and/or drinks in children, which has been found to be a significant factor in contributing to childhood obesity (Harrington, 2008), fatty liver disease (Goran, 2013), and tooth decay (NHS, 2016). The associated health outcomes of smoking tobacco include, but are not limited to, lung and other cancers, coronary heart disease, and stroke (NHS, 2018b). The associated health outcomes for regular and/or excessive alcohol intake include liver disease (Szabo & Mandrekar, 2010) and various cancers (Room & Rehm, 2011).

Despite the significant health risks associated with the example behaviours given above (intake of sugar, smoking, and alcohol consumption), many people still engage in these behaviours. United States (U.S.) sugary-soft drink consumption levels have increased by 300% over the past 20 years, and between 56% and 85% of U.S. schoolchildren consume at least one soft drink each day (Harrington, 2008). Of all adults within the United Kingdom (UK), 17.2% smoked in 2015, with men being more likely to smoke than women. Additionally, those earning less than £10,000 annually or who were at the time looking for work were more likely to smoke (Office for National Statistics, 2017a). Furthermore, the Office for National Statistics (2017b) estimates that 56.9% of individuals aged 16 years and above

drink alcohol, approximately 29 million people, with 7.8 million people drinking to excess (binging) on their heaviest drinking day.

These three examples of negative health-related behaviours alone demonstrate that it is not uncommon for individuals to elect to engage in them regardless of the associated negative health-related outcomes. These negative health-related outcomes are typically disseminated to the public through national campaigns (e.g., Change4Life, Drinkaware, and Smokefree) as well as product packaging displaying nutritional information and images depicting the impacts on health in the specific case of tobacco. Of course, this is not an exhaustive list of negative health-related behaviours; however, the purpose of these examples is to demonstrate that despite the widely known described health risks these activities still form part of daily life for a significant portion of the population. As such, to improve health and wellbeing the promotion of positive health-related behaviour through the modification of health-related behaviours is of significant interest in health psychology.

1.3. Behaviours under investigation

In order to determine the efficacy of a technique or model of behaviour change it must be experimentally tested to determine if a particular behaviour can be modified using it. As such, across two experiments physical inactivity and perceived stress were investigated and are reported within this thesis. The justification for selecting these two outcomes for investigation is their respective pervasive impact upon health and wellbeing in the general public, which are subsequently described for physical inactivity followed by perceived stress.

An individual is considered to be physically inactive if they do not meet the recommended guidelines for physical activity. In the UK this is defined as, on a weekly basis, to engage in at least 150 minutes of moderate-intensity aerobic activity or 75 minutes of vigorous-intensity aerobic activity. It is also recommended that major muscle strength exercises should be included (NHS, 2018a). Physical inactivity has been associated with a number of health-related outcomes including, for example, lower health-related quality of life (Omorou, Langlois, Lecomte, Briançon, & Vuillemin, 2016), and disruption to physical and social functioning as well as mental health (Wang, Sereika, Styn, & Burke, 2013).

On average, people's energy intake is decreasing but, despite this, the occurrence of obesity around the world is increasing. This increase in the prevalence of obesity is postulated to be a direct result of reduced levels of physical activity (Lee & Kim, 2015). There is a well-researched association between engagement in physical activity and body weight and physical activity is considered to be a significant contributor for maintained weight loss (Svetkey et al., 2008). This relationship is of further concern when considering children and adolescents, as pre-adulthood obesity has been found to be a likely predictor of adulthood obesity (Whitaker, Wright, Pepe, Seidel, & Dietz, 1997). Obesity is further detrimental to health due to the other diseases that it is associated with such as cardiovascular diseases, cancers, and diabetes. It is considered to be a leading risk factor for death around the world (Newton et al., 2015; World Health Organization [WHO], 2018) and is thought to explain almost one tenth of premature deaths (Public Health England, 2016).

Public Health England (2017) estimated that the NHS spent £6.1 billion on obesity and excess weight-related ill-health treatment between 2014 and 2015. During this

time obesity and its related diseases were attributed to costing £27 billion to wider society in costs to the employer, dependence upon state benefits, and loss of earnings from reduced productivity. As such, with the ongoing increase in obesity prevalence and decreases in engagement in physical activity (Lee & Kim, 2015), it is to be expected that these costs will increase proportionately as time goes by, with projections estimating costs of £9.7 billion to the NHS and £49.9 billion to wider society by 2050 (Public Health England, 2017).

On the other hand, engaging in physical activity has been documented to produce positive and desirable physical health outcomes such as reducing the occurrence of a range of diseases including, but not limited to, cardiovascular disease, diabetes, and obesity (Warburton, Nicol, & Bredin, 2006) as well as benefits to mental health such as combating depression (Pickett, Kendrick, & Yardley, 2017), improving body image (Campbell & Hausenblas, 2009), and facilitating positive affect and energetic arousal (Lutz et al., 2008).

The second outcome of investigation within this thesis, perceived stress, is a broad concept that is not necessarily negative to health or life, for example eustress is a positive stress response that encourages motivation to complete a task (Sutherland & Cooper, 1990). Exposure to stressors that results in distress is associated with the potential for negative health-related outcomes to manifest, for example, depression (Paykel, 2001) and anxiety (Faravelli & Pallanti, 1989). Other health outcomes associated with exposure to stress include infection vulnerability due to suppression of the immune system (Braveman, Egerter, & Mockenhaupt, 2011) as well as disruptions to normal sleep, leading to tiredness (NHS, 2017). Stress and its related diseases were responsible for the estimated costs of £5.2 billion to society as a whole, including treatment costs and costs to employers in

the UK between 2013 and 2014 (Health and Safety Executive [HSE], 2016).

Between 2017 and 2018 44% of work-related ill-health and 57% of working days, 15.4 million days, lost due to ill-health were accounted for by stress and its related diseases (HSE, 2018).

Improving an individual's physiological and psychological reactions to stressor exposure would result in a reduced cost to society as well as increased productivity. Furthermore, better stress-coping techniques and strategies lead to a reduction in psychological disturbance and physical illness and may act as a buffer to physical and psychological harm from future stressor exposure (Thoits, 1995).

The health impacts, costs of, and benefits from modifying the behaviour of physical inactivity and perceived stress have been highlighted in this section.

These factors serve as a justification for why in particular these behavioural outcomes have been chosen for investigation in the research presented within this thesis.

1.4. Psychology and behaviour change

Positive health-related behaviour change represents an important area of inquiry for health psychology, this involves developing models and theory, through research, to explain how negative or undesirable behaviour can be modified into positive behaviour. Motivating individuals to engage in positive health-related behaviour, especially those disinclined to, poses a significant challenge that is faced by health psychologists and developing this area of research is of great importance due to the potential health and economic benefits that it may entail.

There are many reasons why furthering our understanding of behaviour modification and thereby developing more efficacious treatment regimens is

important. The importance of developing effective strategies of behaviour modification can be seen in the costs that preventable diseases and illnesses have upon healthcare and wider society. As identified, between 2014 and 2015 obesity and excess weight-related treatment cost £6.1 billion (Public Health England, 2017) and stress related ill-health cost £5.2 billion in treatment and lost productivity between 2013 and 2014 (HSE, 2016; HSE, 2018; Public Health England, 2017). If behaviour could be modified into health-benefiting behaviour before the onset of obesity- or stress-related illness then the costs and resources that are currently used in the treatment of these outcomes could be reduced by effectively treating in a proactive manner rather than reactive. This, in turn, would allow healthcare professionals to dedicate further resources and time into the treatment of other illnesses and disease.

Presently, a variety of models describe the fundamental concepts and factors, such as intra-personal and environmental factors, that are thought to be required in order for a process of behaviour change to occur and to be effective. Examples of such models include the theory of reasoned action (Ajzen & Fishbein, 1980) and its further development as the theory of planned behaviour (Ajzen, 1991) and the reasoned action approach (Fishbein & Ajzen, 2010); the health belief model (Maiman & Becker, 1974); the transtheoretical model of behaviour change (Prochaska & DiClemente, 1983); and protection motivation theory (Rogers, 1983). These models typically describe a number of stages or factors that an individual needs to satisfy or move through before successful behaviour change can occur. For example the theory of planned behaviour can be visualised as presented in Figure 1.1.

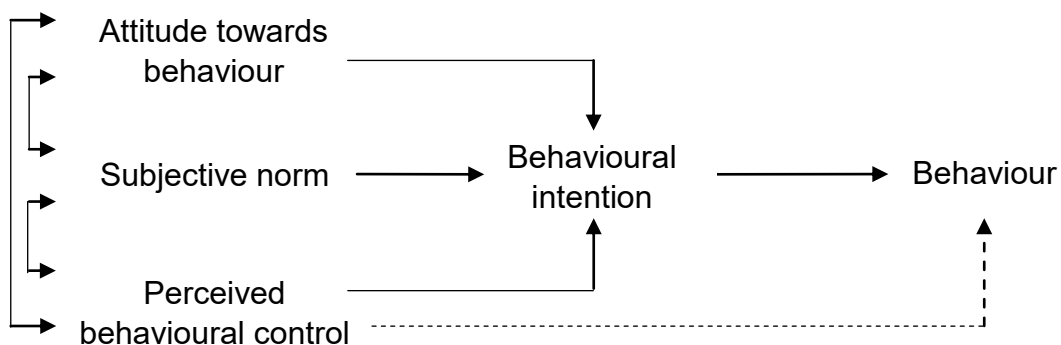


Figure 1.1. The theory of planned behaviour (Ajzen, 1991).

The theory of planned behaviour describes a series of factors (attitude towards a behaviour, associated subjective norms of the behaviour, and the individual's perceived behavioural control), which are bidirectionally correlated. As such, the theory of planned behaviour suggests that the three important factors in adopting a behaviour are an individual's personal thoughts and beliefs about the particular behaviour, the general practices and/or views of society or perhaps smaller relevant social groups such as family, friends, or colleagues, and the individual's belief in their ability to be capable of initiating a behaviour.

Many of the established behaviour change models and theories postulate certain commonalities that are widely agreed upon to be fundamental in the modification of behaviour. For example, the perceived behavioural control component of the theory of planned behaviour is comparable to a concept known more commonly as self-efficacy, which is an individual's perceived ability in themselves to engage in a task to achieve intended or desired results and was first described by Bandura (1977). Bandura (1977) postulated that individuals with high self-efficacy are more likely to view difficult tasks as something that they themselves can tackle and accomplish rather than something that should be avoided. Numerous studies have supported the claim of behaviour change models that self-efficacy is a significant contributor to successful modification of behaviour for example with weight loss

through dietary adherence (Warziski, Sereika, Styn, Music, & Burke, 2008), increasing fruit and vegetable consumption (Kreausukon, 2012) and reducing smoking frequency (Romanowich, Mintz, & Lamb, 2009).

Social support is considered to be an influential factor in whether or not behaviour can be successfully modified and maintained, which can be seen within a number of behaviour change models as well as self-efficacy. For example, subjective norm within the theory of planned behaviour suggests that a behaviour is more likely to be adopted if certain social groups that are relevant to the individual or society as a whole approve or support the particular behaviour. Subjective norm and social support are not synonymous, however they do both align in describing a construct that pertains to social influence and its effect on an individual's intended future behaviour (Draper, Grobler, Micklesfield, & Norris, 2015; Wankel, Mummery, Stephens, & Craig, 1994). Additionally, it is likely that social support and subjective norms are predictive of one-another in that the receiving of social support following a particular behaviour may normalise such behaviour within an individual's social circles (Segrin & Passalacqua, 2010; Soto, Arredondo, Haughton, & Shakya, 2018)

The transtheoretical model of behaviour change describes 10 processes of change that individuals might apply to assist in progressing through the contemplation, action, and maintenance stages of the model and represent cognitive, affective, and evaluative processes (Prochaska & Velicer, 1997). Certain elements of the processes of change can be associated with social support, firstly, environmental re-evaluation, which is the understanding of how unhealthy behaviour might impact on others and the potential positive effects changing the behaviour may have on others. Secondly, social liberation, which is the

understanding that society/social groups are supportive and approving of the positive behaviour change. Thirdly, helping relationships, which describes that finding and interacting with other individuals who are supportive of the prospective positive behaviour change is beneficial.

Social support can be defined as a psychological construct responsible for the manifestation of resources that individuals derive as a result of their intra-personal relationships with other individuals such as family, friends, and colleagues (Cohen & Hoberman, 1983). Numerous studies have been conducted and have documented the beneficial impact that social support has on successful behaviour change. Examples include smoking cessation where it contributed synergistically with individual self-regulation (Ochsner et al., 2014) as well as modifying obesogenic behaviours by enhancing diet quality and increasing physical activity, which was associated with higher workplace social support (Tamers et al., 2015).

Social support as a psychological construct is not singular in nature, instead it covers a broad range of types of support. Moreover, there are differences in how individuals respond to experiencing actual received social support and perceived social support (Barrera, 1986). A more comprehensive account of social support is provided within the literature review (Chapter 2).

As such, self-efficacy and social support both appear to be of significant research interest in developing and maintaining an understanding of achieving successful positive health-related behaviour change. Therefore, both self-efficacy and social support are used within the theoretical framework of the research presented in this thesis, which is described extensively within the literature review (Chapter 2).

1.5. Technology and behaviour change

In an effort to further improve the efficacy of and development of new more effective behaviour modification strategies, emergent technologies have begun to be incorporated as tools to achieve these goals. Examples include the use of wearable technology, such as Fitbit smart watches, in making physical activity more enjoyable and therefore more likely to be engaged in (O'brien & Mueller, 2007) and smartphone applications (apps) have been used to promote weight loss (Pretlow, Stock, Alison, & Roeger, 2015) or participation in physical activity (Conroy, Yang, & Maher, 2014; Yang, Maher, & Conroy, 2015). Social media have been investigated and found to be a potentially effective tool for distributing health behaviour knowledge and achieving health-related behaviour outcomes (Korda & Itani, 2013).

Technological innovation opens new avenues of inquiry to researchers who are interested in developing more effective means to modify behaviour in a positive direction; one such innovation is that of computer games. There are a number of factors that are unique to this entertainment medium that may contribute to the potential of using this technology as a facilitator for positive behaviour change.

One such factor is the prevalence of computer game technology and its use. UK Interactive Entertainment ([UKIE] 2017) estimate, that the number of computer game players within the UK is 31.6 million, approximately half of the UK's population. Other factors that may contribute to the potential of using computer games as a facilitator of positive health-related behaviour change, such as methods of interaction, genre, and capacity for multiplayer game play, are presented in Section 2.2. Computer games are a relatively cheap and accessible

form of entertainment technology that has exposure to a large portion of the UK's population can have significant value as a tool to facilitate positive health-related behaviour change. A recent example of this can be seen in the emergence of computer games for physical exercise, known as exergames. Exergames are computer games that include physical activity or movement as a primary form of interaction with the game, this is typically achieved using infra-red or motion sensors. Engaging in exergame play has been found to help in alleviating depressive symptomology (Li, Theng, & Foo, 2016) as well as improving motivation to exercise (Sun, 2013).

1.6. A brief introduction to the theoretical framework

The proposition that computer games can be used in successful interventions that facilitate positive health-related behaviour change is supported by the theoretical framework that has been adopted by the research that is presented in this thesis. This framework is described in brief here and is comprehensively covered within the literature review (Chapter 2). The purpose of including the brief summary here is to facilitate a more complete understanding of the thesis' aims which are presented within Section 1.7.

In order to describe the theoretical framework that is used within this thesis first it is necessary to have an understanding of what leisure is. Iso-Ahola (1997) describes leisure as a global construct defined by a state of being rather than something that is determined by time, money, or activity. Iwasaki (2003a) highlights that one of the unique aspects of leisure is the opportunity that it provides for individuals to exercise freedom and a sense of control in comparison to other mundane activities, such as work. As such, these qualities, freedom to

engage in activities for leisure and intrinsic motivation to do so, are fundamental to achieving a leisure state (Iso-Ahola, 1997).

Iwasaki and Mannell (2000) developed their hierarchical model of leisure stress coping to describe how engagement in leisure activities, such as playing computer games, can help individuals to better cope with stress. The model proposes that engagement in leisurely pursuits provides opportunities for enhanced stress coping. The model distinguishes between beliefs in how an individual believes that their leisure involvement helps stress coping and situation-specific behaviours, such as cognitive strategies, which leisure engagement can provide for better coping when stress is encountered.

A significant element of the leisure coping beliefs dimension, leisure friendships, describes the forms of social support that can be facilitated through leisure including emotional support, esteem support, tangible aid, and informational support. The leisure friendships component of the model therefore refers to beliefs that an individual's friendships that have been developed through leisure are a source of social support (Coleman & Iso-Ahola, 1993; Iwasaki, 2003a; Iwasaki & Mannell, 2000). Supporting the leisure coping framework, social support has been identified as a fundamental motivation for engagement in computer game play, suggesting that computer game engagement can be facilitative of socially supportive environments for players of computer games (Longman, O'Connor, & Obst, 2009; Stenros, Paavilainen, & Mäyrä, 2009).

Social support has been strongly associated with facilitating self-efficacy through means such as verbal persuasion, verbal encouragement, and vicarious experiences (Bandura, 1989; Resnick, Orwig, Magaziner, & Wynne, 2002; Peterson, Lawman, Wilson, Fairchild, & van Horn, 2013). Consequently, the

application of Iwasaki and Mannell's (2000) hierarchical model of leisure stress coping establishes the socially supportive nature of leisure engagement and therefore that of computer games. Furthermore, the association between social support and self-efficacy and the importance of self-efficacy in promoting positive health-related behaviour change culminate in the proposal of a mediating model of behaviour change (Figure 1.2.). In this model, social support, facilitated through leisure engagement, acts as the predictor, self-efficacy as the mediator, and positive health-related behaviour change as the outcome.

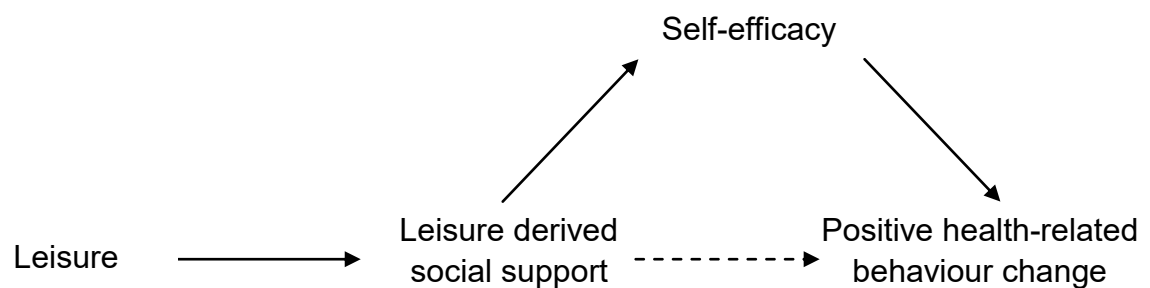


Figure 1.2. Proposed association between social support, derived from leisure, self-efficacy, and positive behaviour change.

1.7. Research aims

The research that is presented in this thesis has been conducted in an effort to satisfy a series of research aims, firstly, to investigate the role of sociable computer game play in facilitating social support, self-efficacy, and positive health-related behaviour change. Secondly, to demonstrate the capacity for sociable computer game play to elicit positive health-related behaviour change across two health-related behaviours. Thirdly, to investigate the process in which positive health-related behaviour change may occur following changes in self-efficacy and social support from sociable computer game play. For clarity, these research aims are explicitly stated, following a literature review, in Section 2.5.1., alongside formulated research questions in Section 2.5.2.

1.8. Structure of the thesis

The thesis is structured to describe in depth to the reader the design and findings of three studies. Studies 1 and 2 test the proposed mediation model, but the first examines the outcome variable of physical activity, whilst the second examines the outcome variable of perceived stress. Study 3 supplements the findings of Study 2 and the thesis' theoretical framework using qualitative methods.

Chapter 2 represents the thesis' literature review and opens with an account of the cultural significance that computer games have in the modern day. The literature review proceeds to describe and explain the theoretical underpinnings of the research presented in the thesis and attempts to explain how sociable computer game play facilitates social support, which in turn encourages, through self-efficacy as a mediator, positive health-related behaviour change.

Chapter 3 presents the first study, which investigates the mediation model in the domain of increasing physical activity.

Chapter 4 presents the second study, which investigates the mediation model in the domain of reducing perceived stress.

Chapter 5 presents the third study, which investigates sociable computer game play using qualitative methods.

Chapter 6 presents a general discussion of the relevant literature and studies performed. Here strengths and limitations of the research are reported, along with appropriate recommendations for future inquiry and application. Original contributions to knowledge that have been made by the research contained this thesis are also outlined.

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2.1. Overview

This chapter presents a review of relevant literature to describe and explain the theoretical underpinnings and framework that will be used within the thesis.

Furthermore, included is a brief acknowledgement of the cultural significance and use of computer games within society. It is important to provide contextual information about this medium of entertainment in order to explain why the potential use of it as a therapeutic tool may be relevant. The (sub-)sections within this chapter are ordered to form a logical sequence that explains the relationships between the psychosocial factors that are under investigation.

An extensive literature search was performed in which literature, relevant to the research presented in this thesis, was identified and included with the aim of providing a basis of evidence to support the theoretical underpinnings of the research that has been carried out. A variety of scholarly databases and public sources were used to access material, these sources were ACM Digital library, AMED, ASSIA, CINAHL Complete, Cochrane Library Online, Google Scholar, MEDLINE, PsycARTICLES, Psychology and Behavioural Sciences Collection, PsycINFO, ScienceDirect, Scopus, SPORTDiscus with full text, and Teesside University's Middlesbrough campus library. Accessed material is comprised of peer reviewed journal articles (published and in-press), dissertation theses, academic conference proceedings, books, websites, governmental white papers, (inter)national public health institution publications, and commercial industry information. Keywords that were used in the literature search included computer games, leisure, leisure stress coping, social support, self-efficacy, physical activity, and perceived stress; synonyms of these key words were also used, such as video/digital games, exercise, and stress, for example, in order to return as many

search results as possible where differing terms may be used. Lastly, a range of literature searching methods and techniques were used in the process of conducting the literature search such as using certain parameters to further refine searches. This included a preference for, but not exclusively, searches to return items with full-text documents available rather than only abstracts.

2.2. A brief account of computer games

Computer games are a relatively new medium of electronic entertainment that was first brought to mainstream audiences during the 1980's with the introduction of the Atari and Nintendo consoles (Williams, 2006). The computer games industry represented a market valued globally at \$116 billion (£82.22 billion) in 2017 and has been projected to be valued at \$143.5 billion (£101.71 billion) by 2020 (UKIE, 2018). UKIE (2018) reported that the UK computer game market, including physical and digital sales, reached a value of £3.35 billion, the 5th largest globally, and was 1.3 times the size of the video market (£2.25 billion) and 2.6 times the size of the music market (£1.1 billion) in 2016.

2.2.1. Developments in computer game technology.

Technological developments have brought about an exponential growth in computing power since the observation made by Moore (1965), known as Moore's Law, who described that the number of transistors on a computer chip will double every 18 months. This has occurred, as predicted, since 1958 with the invention of the integrated circuit and is only recently slowing down. This rapid advancement in computing power has been the driving force behind the development of ever-more sophisticated computer gaming machines and games. The earliest dedicated domestic gaming machines, commonly known as consoles, that were

manufactured, such as the Nintendo Entertainment System, were capable of 8-bit operations. Comparatively, the most recent commercially available consoles are capable of 64-bit operations, such as the Xbox One, which is manufactured by Microsoft, representing a substantial increase in computing power within in-home entertainment consoles.

One feature of computer games that has changed over time is the interaction with their player(s). This is unusual to consider, as other forms of electronic media have remained typically static in how they are interacted with such as television and radio. Computer games typically utilise remote controllers or game pads that facilitate their player's interaction and these have gradually become more sophisticated, with additional features being supplemented over time. Originally, consoles included basic controllers consisting of four buttons, which typically served as action inputs, and a four-way directional arrangement of buttons for navigation of game worlds and menus. More recent console controller designs have included joysticks or thumb sticks in place of directional buttons, allowing for precision input of movement control, as well as features such as rumble simulators (that provide kinaesthetic feedback), motion sensors, touch screen displays, and microphones.

Innovations have led to the development of computer games that players primarily interact with through bodily movement. This was popularised by the Nintendo Wii in 2006 and has been a commonly included feature in most console gaming technology since. A result of the inclusion of movement-based computer games is that of exergaming. Exergames are computer games that have been designed to require physical activity as a means of interacting with the game (Sinclair, Hingston, & Masek, 2007). This is commonly done through tracking bodily

movements and gestures using a range of methods including infra-red motion sensors, accelerometers, and camera recognition technology. This shift in game peripheral design has allowed for computer games to be designed as more immersive cinematic experiences that allow players to feel that they are active participants in the game. An example of this is Bianchi-Berthouze, Kim, and Patel (2007) who found that an increase in body movement during computer game play resulted in an increase in player's engagement and a greater affective experience.

The most recent innovations in computer games hardware technology have been designed in an attempt to create entirely immersive and interactive gaming experiences through virtual reality. An example of this is the development of stereoscopic headsets with incorporated positional tracking systems as seen within devices like the Oculus Rift. These devices attempt to simulate a game world, providing the player with a first-person perspective, thereby facilitating a perception that the player is inside the game world rather than in the real world. Positional tracking facilitates additional immersion, where game exploration is achieved through motion, for example moving your head will cause you to look around within the game. Hand-held peripherals can be used in tandem with the headsets, allowing a player to look around the virtual environment and manipulate objects with their hands as well.

Mobile gaming or app-based computer games have become increasingly popular recently. A pertinent example is that of Pokémon Go, an augmented-reality mobile game that was released in 2016. Despite their infancy, these types of games have claimed a large portion of the computer games market valued at \$61.8 billion (£43.7 billion), with the UK representing the 4th and 6th largest markets globally for mobile games and apps on the Apple and Android operating systems, respectively

(UKIE, 2018). These particular computer games have been described as casual video games both within scientific literature and by the wider public, and have become popular, especially with older audiences (Whitbourne, Krauss, & Akimoto, 2013). It is thought that mobile gaming's rise in popularity can be explained by their typically simple and easy-to-learn designs as well as their availability on a number of platforms including social networking sites, smartphones, and tablet computers. Another factor contributing to mobile gaming's popularity is the fact that they are designed to typically not require significant time investments to play or progress meaningfully in (Russoniello, O'Brien, & Parks, 2009).

2.2.2. Differences between computer games and methods of interaction.

Another feature that computer games have in common with other mediums of entertainment such as films and books is that of genres. In film for example, a genre may elucidate what to expect from viewing it, whether it will be fast-paced, exciting or comical perhaps. The role of genre in computer games is similar in purpose, but in addition to informing expectations regarding music and narrative it also provides the player with expectations of what game mechanics (constructs of rules and methods for game interaction) to expect, such as the objectives of the game and the means that are available to the player to achieve them. For example, the expected goals in a first-person shooter computer game would be to shoot other avatars (computer-controlled characters or other human players) using a projectile weapon from the first-person perspective. However, a more in-depth view provides the expectations that it will be a fast-paced game, likely to be competitive, may include violence as well as the potential of mature imagery such as blood effects (Smith, 2006). Presently, computer games are typically divided

into seven genres: sports, driving/racing, simulation, strategy, role-playing, first-person shooter, and action-adventure, each of which are synonymous with a unique set of expected game mechanics and other features that are typically exclusive to that particular genre (Smith, 2006).

Computer games offer additional avenues of entertainment that other forms of electronic media do not, a noteworthy aspect of a variety of computer games is their multiplayer component, which when engaged with makes a computer game-playing experience inherently a sociable one. In an offline setting, computer games can typically offer support for up to four local simultaneous players; however, Internet networking technology has made online multiplayer a possibility, in which any number of simultaneous players, limited only by the specific allowances of each particular computer game, can play together. Stenros et al. (2009) have postulated that all computer games may be considered to be inherently sociable activities. Single-player games can be thought of as such due to the presence of scoring systems, achievements, and the knowledge that other people play. More obviously, two-player games, multiplayer games (two-to-four players), and massively multiplayer online games (which can facilitate simultaneous play between thousands of simultaneous players) are sociable through in-game actions with other players but also through real-world actions if players are co-located with one another. The dynamics of multiplayer games can vary, for example whether the objective of the game is to work collaboratively towards a common goal or competitively to defeat the opposing player(s).

2.2.3. Demographics of gamers.

To further develop an understanding of the popularity of computer games, in addition to examining the fiscal size of the industry, measuring the characteristics of those who play computer games can provide useful information. Williams (2006) suggests that adults are now significantly more likely than ever before to regularly engage in computer game play unlike their predecessors during the 1980's who typically dropped this hobby due to a perception of public shaming that computer games were exclusively for children (Williams, 2003). This change in public attitude has allowed for computer games to become recognised as a proper or legitimate leisure activity to engage in. As a result, computer games have become a mainstream medium of entertainment, as demonstrated by the fiscal significance of the industry reported earlier and the following information pertaining to the frequency of game use and the demography of players.

Williams, Yee, and Caplan (2008) found that 40% of adults and 83% of teenagers are regular computer game players and that the average player age is 33 years. Supporting these findings, a survey conducted by the Entertainment Software Association (2017), using data gathered from over 4,000 U.S. households, suggest that 65% of U.S. households have at least one individual who actively plays computer games (three or more hours weekly) and 67% of U.S. households own a dedicated gaming console. UKIE (2018) reported that approximately 50% (32.4 million) of the UK population play computer games.

U.S. demographic information supports Williams et al.'s (2008) findings suggesting that the average player age is 35, and that the gender ratio of male to female computer game players is 59% to 41%, respectively. The proportion of male and

female U.S. computer game players is almost congruent with that of the UK, where 58% of computer game players are male and 42% female are female (UKIE, 2018). UKIE (2018) report that the most common age brackets of people within the UK who play computer games is 15–24 years for males and 45–64 years for females. This information helps to demonstrate the acceptance of computer games as a popular medium of entertainment as, historically, computer game play was typically an adolescent male-dominated pursuit (McQuivey, 2001). In contrast, however, Yee (2006a) found that the average player age of massively multiplayer online role-playing games (MMORPGs – a genre of computer game characterised by large persistent game worlds that encourage player interaction) was 26.6 years, this might suggest that different genres of computer game appeal to different demographics of society. MMORPGs are typically associated with requiring large time investments to play properly and gain meaningful advancement within them (Williams et al., 2008). As such, computer games such as MMORPGs may not appeal to those with more time-constrained lifestyles, for example, those working or studying full-time or raising children.

Lastly, a brief investigation into the amount of time that is typically invested into computer game play is given. According to information collected by UKIE (2018), on average, 11–64 year-old gamers within the UK spend 8.2 hours per week playing computer games. This is more than the average amount of time spent playing computer games in Germany, France, and Spain where the average is 7.2 hours, 6.8 hours, and 6.4 hours, respectively.

2.2.4. Cultural impact of computer games.

As previously described, the development and widespread use of computer games have led to a large and still growing market with a diverse consumer base. With such a large presence, computer games have come to have a range of impacts on society and life in general.

2.2.4.1. Perceived negative impacts of computer games.

It is inevitable that with the size of an industry such as that of computer games that a number of controversies regarding their use have arisen. As has happened with almost every other form of media entertainment in their infancy, moral panics (social concern over a problem that is perceived to be a threat to societal values or interests [Cohen, 2011]) emerge. With computer games a number of such instances have occurred and in some cases are still ongoing. Examples of these include the following: the concerns that computer games cause children/adolescents to become violent, and that computer games are addictive and may cause delinquency.

The relationship between violent computer games causing players to become violent can be seen as a product of media sensationalism. It is often after mass shootings, for example, that computer games are suggested to be responsible for the perpetrator's actions (Ferguson, 2014). Such instances include the mass shootings at Columbine high school in 1999 and the Sandy Hook elementary school in 2012 in the U.S. and that of Anders Breivik in Norway in 2011. In each of these cases, violent computer games were put forward as speculation and rumour by reputable sources such as news outlets and lawmakers as explanative of the

perpetrator's actions, although limited scientific evidence was presented (Ferguson, 2014; Ferguson & Beaver, 2016).

Cunningham, Engelstätter, and Ward (2011) have suggested that, while violent computer game play may be associated with increases in aggression, they can have an opposing effect in contributing to a reduction of crime. They postulate that the time that is spent playing computer games reduces the amount of possible time that may be spent engaging in antisocial activities, thereby reducing the occurrence of criminal activity. Correlational results support the argument that computer games causing violence is in no-way a clear-cut association, as found by Ferguson (2013). The author found that when computer games became more popular and more graphic, the rates of violent crime (including that committed by youth) steadily decreased. Ferguson (2013) argues that this was seen most dramatically within the U.S., in which the relatively high rate of violence, for a developed country, decreased to a 10-year low between 1996 and 2006, during which sales of computer games increased. It is important to add that these results are correlational and that there may be other variables that explain this reduction in violent crime that occurred at the same time that violent computer games became more popular.

More recently, the argument that computer games are causing and can cause addiction has been gathering attention. The 5th edition of the DSM-5 contains 'Internet Gaming Disorder' within its Conditions for Further Study section (American Psychiatric Association [APA], 2013). Entries contained within this section have proposed criteria for the purposes of research to better understand and to determine if Internet Gaming Disorder is to be accepted as a clinical psychological disorder within future editions of the DSM. As of yet, the APA has

not determined whether or not Internet Gaming Addiction holds sufficient evidence to be re-classified as a clinical disorder.

Despite this, the WHO has included gaming disorder within the 11th revision of the international classification of diseases (ICD-11; WHO, 2018a). As such, gaming disorder is considered, by the WHO, to be a clinically significant and recognisable syndrome defined by three criteria: lack of control in playing computer games, prioritising computer game play over other interests and responsibilities, and an inability to stop engaging in computer game play even after being affected negatively by excessive computer game play (WHO, 2018a). The inclusion of gaming disorder into the WHO's classification of diseases has led to some children being treated for excessive computer game play and addiction rehabilitation.

Conversely however, more research is beginning to be published looking at the potential positive qualities that computer games can have upon consumers. The notion that computer game play can produce beneficial qualities is of great research interest. Examples of positive psycho-social outcomes from computer game play include improved social support (Longman et al., 2009) and the experience of flow states (Barry, van Schaik, MacSween, Dixon, & Martin, 2016; Cowley, Charles, Black, & Hickey, 2008; Robinson, Dixon, Macsween, van Schaik, & Martin, 2015).

2.2.4.2. Positive impacts of computer games.

A significant example of computer games increasing acceptance within the public eye, and therefore its legitimacy as a leisure activity and medium of entertainment, is that of e-sports. E-sports are computer game-based competitions or tournaments typically involving professional players and are broadcast live and

reward prize money to competitors. E-sporting events have become increasingly popular to watch throughout the world over the past few years. For example, in South Korea these events are exceptionally popular, where spectators can outnumber those watching traditional sporting events (Taylor, 2012). Global viewership of e-sport events includes over 213 million people which is expected to rise to a global audience of 303 million by 2019 (SuperData Research, 2016).

In total approximately \$423 million (£297 million) has been awarded in prize money over the course of twenty-six thousand e-sport tournaments with the single largest prize pool of \$24,687,919 (£17.3 million) in 2017 and 53 other tournament events awarding \$1 million or more in prize money between 2013 and the present day (E-sports earnings, 2018). Online viewing of other people playing computer games through companies such as Twitch.TV, introduced in June 2011, which is a live streaming platform designed specifically for the online broadcasting of live computer game footage. This has become popular with more than 2.2 million unique broadcasters and over 100 million unique viewers per month in 2016 (Twitch TV, 2016).

The presented information within Section 2.2. demonstrates the acceptance of computer games at present as a legitimate medium of entertainment, leisure pursuit and competition for people of all ages, whether male or female. It was important to describe the growth of, current trends, and population of computer game players, and those who play them as the research that is presented within this thesis is primarily interested in investigating the role that computer games can have in facilitating positive health-related behaviour change. As such, any recommended computer game-based intervention or treatment programme could

be easily adopted and engaged in by a wide proportion of the population in the UK or elsewhere in the world.

2.3. Leisure stress coping

In Section 2.2. the scope of computer games as a medium of popular entertainment was established. This has been achieved by including a consideration of the financial value of the computer games industry as well as highlighting the prevalence of computer game play in society and descriptions of the characteristics of the computer game-playing population. This section is devoted to presenting and describing Iwasaki and Mannell's (2000) hierarchical model of leisure stress coping and explaining why it is of central significance within this thesis.

The leisure stress coping model (Iwasaki & Mannell, 2000) is a synthesis of other leisure stress research that aims to classify the identified dimensions of leisure stress coping (leisure contributing to individual's ability to cope with stress) into a hierarchically organised framework, which is presented in Figure 2.1. Each level of the hierarchy from top-to-bottom present increasingly specific elements of leisure stress coping and are presented in Figures 2.2., 2.3., and 2.4., for levels one, two, and three, respectively.

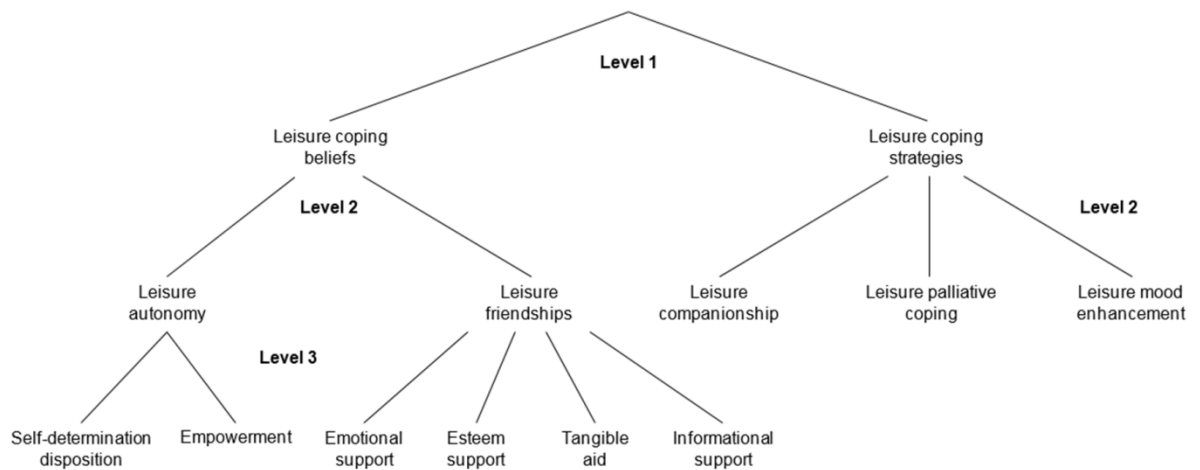


Figure 2.1. Iwasaki and Mannell's (2000) hierarchical model of the dimensions of leisure stress coping.

2.3.1. Level 1: Leisure coping beliefs and leisure coping strategies.

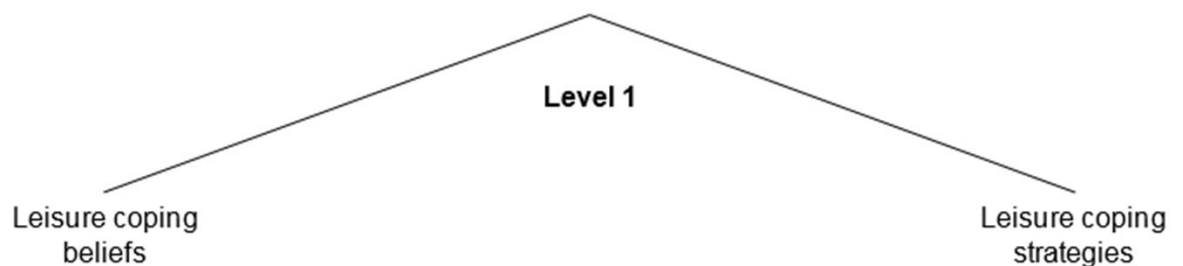


Figure 2.2. Iwasaki and Mannell's (2000) leisure coping model cropped to distinguish the elements of Level 1 of the model.

Level 1 of the model is the initial and most general, in which a distinction is defined between leisure coping beliefs and leisure coping strategies that highlight two important differences in how leisure can affect the experience of stress and thereby help people to cope better.

2.3.1.1. Leisure coping beliefs.

Leisure coping beliefs are the beliefs that people may hold that their leisure participation plays an active role in helping them to cope with stress. Leisure-oriented beliefs are thought to develop over time and are maintained through leisure socialisation. Coleman and Iso-Ahola (1993) suggest that leisure-derived dispositions or beliefs can act as buffers or moderate against the deleterious effect

on health that stress can have. To clarify, benefits to health that are attributable to leisure-derived dispositions or beliefs occur as a response to stress. As such, Coleman and Iso-Ahola (1993) further suggest that the highly social nature of leisure may facilitate the development of friendships and that companionship in shared leisure activities can provide effective relief from stressors due to the perception of social support.

2.3.1.2. Leisure coping strategies.

Leisure coping strategies are different from leisure coping beliefs in that they represent actual real-world behaviours and/or cognitions that are available through active participation in leisure. As such, leisure coping strategies are conceptualised as more situation-specific and volitional than leisure coping beliefs are and their use and effectiveness are assumed to differ depending upon the specific life circumstances that an individual has. As a result, the dimension of leisure coping strategies suggests that people may choose certain leisure activities purposefully to generate certain behaviours or cognitions that they know will help them to cope with stress. Alternatively, it is possible to find that a leisure activity has provided a leisure stress-coping experience although the leisure activity was chosen for other reasons.

As such, leisure coping strategies consider a coping action to be representative of a process of behaviour. Therefore, when an individual encounters a stressful event they may engage in a certain coping action, engagement in a leisure activity perhaps, in response to this event; situational and/or contextual factors may influence the particular leisure activity that is chosen. For example, escape-orientated leisure might be specifically chosen following an increase in work-

related demands or mood enhancement-orientated leisure might be chosen after a disagreement with a significant other. Iwasaki and Mannell (2000) consider leisure coping strategies to act as mediators in the stress and health relationship where a stressful stimulus triggers participation in a particular leisure activity to facilitate better coping and therefore better health.

2.3.2. Level 2: Sub-dimensions of leisure coping beliefs and leisure coping strategies.

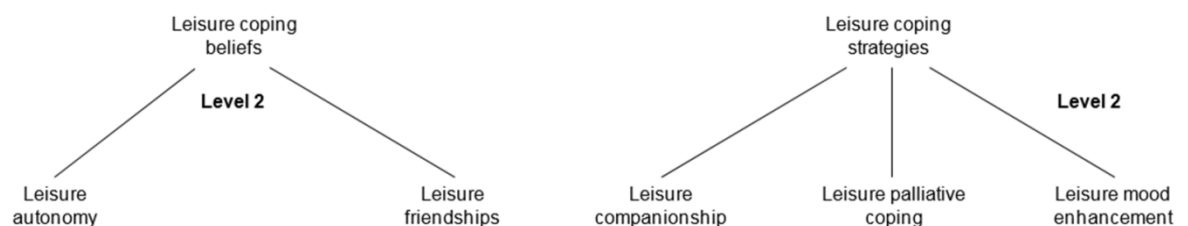


Figure 2.3. Iwasaki and Mannell's (2000) leisure coping model cropped to distinguish the elements of Level 2 of the model.

At the second level of the model the dimensions presented at Level 1 of the model (leisure coping beliefs and leisure coping strategies) are broken into the more specific sub-dimensions. This results in the specification of two major sub-dimensions of leisure coping beliefs, leisure autonomy and leisure friendships, and three major sub-dimensions of leisure coping strategies, leisure companionship, leisure palliative coping, and leisure mood enhancement.

2.3.2.1. Sub-dimensions of leisure coping beliefs.

Leisure autonomy encapsulates the beliefs that leisure is volitional and that it also helps to develop certain personality characteristics that allow for more effective stress coping, such as a sense of control over one's actions and intrinsic motivation.

The Leisure friendships sub-dimension, on the other hand, describes the beliefs that any friendships and relationships that have been developed through leisure participation can facilitate social support to the individual, thereby providing them with the resources necessary to better cope.

2.3.2.2. Sub-dimensions of leisure coping strategies.

Leisure companionship facilitates discretionary as well as enjoyable shared experiences with others and acts as a form of social support. Both the leisure friendships sub-dimension of leisure coping beliefs as well as the leisure companionship sub-dimension of leisure coping strategies act as conduits for social support; however, they are distinctly different. Leisure friendships is concerned with the perception of social support whereas, leisure companionship is concerned with physical actions to engage in a socially supportive environment.

Leisure palliative coping represents an escape-oriented stress coping strategy that allows an individual to escape temporarily from stressful events through leisure giving them the opportunity to refresh themselves and to regroup to better handle the problems at hand. An example of this could be taking a holiday.

Leisure mood enhancement represents the specific utilisation of a leisure activity to either elevate positive mood or diminish negative mood thereby facilitating better stress-coping.

2.3.3. Level 3: Sub-dimensions of leisure autonomy and leisure friendships.

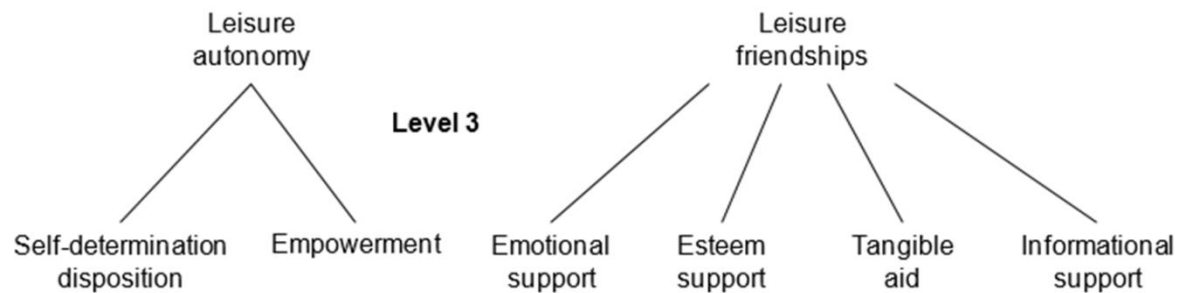


Figure 2.4. Iwasaki and Mannell's (2000) leisure coping model cropped to distinguish the elements of Level 3 of the model.

At the most specific level of the leisure stress coping model, leisure autonomy can be seen to be comprised of two sub-dimensions, which are self-determination disposition and empowerment. Leisure friendships can be seen to be comprised of four sub-dimensions which are emotional support, esteem support, tangible aid, and informational support.

2.3.3.1. Sub-dimensions of leisure autonomy.

A self-determination disposition is described as a belief that one's actions are self-determined, in other words, under one's own control. In the instance of this model, this represents a belief that one's leisure behaviour is freely chosen and at the volitional control of the individual.

Leisure empowerment describes the belief that an individual has that they are entitled to opportunities for leisure. Further to this, leisure empowerment describes that participation in leisure provides the opportunity for self-expression, the communication of personal feelings, thoughts, and values to others. This facilitates the development of a valued sense of self, which is the sense of one's own worth as a person.

2.3.3.2. Sub-dimensions of leisure friendships.

The sub-dimensions that comprise the leisure friendships sub-dimension describe the different functional aspects of social support as a multi-dimensional concept that an individual may believe they receive from their leisure involvement. As such, any friendship that has been fostered through leisure participation may help an individual to cope with stress in different ways, dependent upon the individual's specific needs at the time.

Emotional support can be considered to encapsulate the concepts of empathy and compassion for others and can be given to show encouragement, reassurance, or genuine concern for another. Esteem support can be given to another individual following their unsuccessful attempt at a task, for example, in order to help them to regain a sense of self-esteem and confidence. Tangible aid and informational support differ from emotional support and esteem support in that they are more technical in nature and represent tangible resources. Tangible aid represents assistance that can be relied upon to achieve an outcome such as being able to borrow someone's equipment/tools or, alternatively, being able to receive assistance to finish a task that would not be possible or would be significantly more difficult to finish otherwise, such as moving house. Informational support involves the provision of information that has the potential to help others problem-solve or achieve a desired outcome and might take the form of friendly advice, guidance, or supervision.

2.3.4. Support for the hierarchical model of leisure stress coping.

In a review of developments in leisure, stress, and coping research Schneider and Iwasaki (2003) concluded that the majority of present research found evidence to support the conceptualisations of leisure coping beliefs and leisure coping strategies. A selection of such research is presented here.

Iwasaki (2003b) examined leisure's ability to facilitate stress-coping outcomes which included immediate outcomes (perceived coping effectiveness, perceived satisfaction with coping outcomes, and perceived stress reduction), and distal, or long-term outcomes (physical and mental ill-health and psychological well-being) above and beyond the capabilities of general coping (coping that is not associated with leisure). The leisure friendships sub-dimension of leisure coping beliefs was found to significantly predict lower levels of mental and physical ill-health as well as to promote greater levels of psychological well-being. Participants who reported higher levels of leisure empowerment (another sub-dimension of leisure coping beliefs) tended to also report lower levels of mental ill-health and improved psychological well-being. Furthermore, leisure coping strategies significantly predicted perceived coping effectiveness and stress reduction, with leisure mood enhancement being positively associated with perceived coping effectiveness, stress reduction (along with leisure palliative coping), and satisfaction with coping. The findings suggest that the distal/long-term outcomes were better improved by dimensions of leisure coping beliefs whereas dimensions of leisure coping strategies were more effective at improving short-term outcomes.

Similarly, Iwasaki (2001) found that leisure coping, as a whole, significantly predicted all outcome indicators. These were immediate coping outcomes (coping

effectiveness, satisfaction with coping outcomes, and stress reduction), mental ill-health, and psychological well-being above and beyond the effects of general coping. It was, however, found that general coping did significantly predict immediate coping outcomes. Additionally, distinctions were made between leisure coping beliefs and leisure coping strategies, with the former contributing significantly towards all of the measured outcomes and the latter not being found to significantly contribute towards mental ill-health or psychological well-being.

Research conducted involving specific and underrepresented populations has provided evidence for Iwasaki and Mannell's (2000) conceptualisation of leisure stress coping. Iwasaki (2006) investigated the effects of leisure coping, while considering socio-economic standing, sex, and age. It was found that the health-protective effect of leisure coping was more prominent in individuals with lower socio-economic standing than those of higher socio-economic standing, but was prevalent across sex and all age groups. It is suggested that individuals with lower socio-economic standing might benefit more from leisure coping due to having less control over their lives due to, for example, discrimination and poverty and that leisure provides opportunities for self-determination and empowerment, which is lacking in other aspects of their lives.

Iwasaki (2003a), and Iwasaki, Mannell, Smale, and Butcher (2005) both investigated police and emergency response service populations. Iwasaki (2003a) considered the mechanisms by which leisure coping influences the relationship between stressors and adaptational outcomes (coping effectiveness, stress reduction, mental, and physical health). Leisure coping strategies were found to mediate the effects of leisure coping beliefs on adaptational outcomes, with leisure coping beliefs acting as antecedents for the use of leisure coping strategies to deal

with stressors. This is explained in that the development of enduring beliefs about the roles of leisure as ways of coping (leisure coping beliefs) seem essential for the actual and effective use of leisure as a means to manage stress (leisure coping strategies).

Conversely, Iwasaki et al. (2005) investigated the predictive capability of leisure participation frequency and enjoyment in predicting adaptational outcomes. Higher frequencies of social leisure were found to significantly predict greater mental health above that of general coping which supports the identification of conscious participation in leisure to facilitate social support in Iwasaki and Mannell's (2000) model. It was also identified that higher frequencies of participation in cultural leisure improved physical health and outdoor recreation was significantly associated with improved mental health.

Support for leisure providing an opportunity for palliative coping was found by Iwasaki, Mactavish, and MacKay (2005) in a multi-year study using a qualitative focus group design. The study used a diverse sample including aboriginal individuals with diabetes, physically disabled individuals, older adults with arthritis, gays and lesbians, and a group of professional managers. Findings described the importance of creating a 'leisure space' - the creation of distinct opportunities, with the primary purpose to engage in leisure which acts as a form of palliative leisure coping. Certain groups within the sample emphasized the importance of gaining culturally appropriate and meaningful social support through their leisure space.

Iwasaki, MacKay, and Mactavish (2005) investigated how male and female managers cope with stress, aiming to determine if sex differences occurred in leisure coping. Nine themes of stress-coping common to both sexes were found that are congruent with various sub-dimensions in Iwasaki and Mannell's (2000)

hierarchical model of leisure stress coping, such as socialisation through leisure and leisure-generated social support (leisure companionship and leisure friendships), feeling rejuvenated through leisure as well as humour and laughter (leisure mood enhancement), and leisure as personal space (leisure palliative coping).

Heintzman and Mannell (2003) developed a model to describe the relationships between leisure style and spiritual well-being and the processes by which leisure can influence spiritual well-being. Findings suggested that individuals who were more highly motivated to participate in leisure and who engaged more frequently in cultural, outdoor, and hobby activities were more likely to use leisure to sensitise themselves to their spiritual beliefs and to visit locations that facilitate this. The authors equate this to the concept of leisure palliative coping where leisure is used as a means for rejuvenation (spiritual well-being in this instance) to better cope with life's challenges. The authors also suggested that spirituality may be associated and integrated into various leisure coping sub-dimensions such as self-determination, social support, empowerment, palliative coping, and mood enhancement.

2.3.5. Justification for using Iwasaki and Mannell's (2000) hierarchical model of leisure stress coping.

Iwasaki and Mannell's (2000) hierarchical model of leisure stress coping places emphasis on the psychosocial functions that leisure activities can be facilitative of rather than emphasising the benefits of any leisure pursuits in particular. As such, a particular strength of this model is in its applicability to any form of leisure, in which it distinguishes between enduring leisure coping beliefs, situation-specific

behavioural, and/or cognitive leisure coping strategies that may be derived from leisure participation.

Iwasaki and Mannell (2000) drew from a range of empirical research to inform and support the development of their hierarchical model providing it with a rigorous basis of evidence. More recently, a broad range of studies investigating a variety of leisure forms as well as differing populations have been conducted and provide further evidence for Iwasaki and Mannell's (2000) hierarchical conceptualisation of leisure stress coping. Examples include the use of digital games in aiding after-work recovery from work-related strain (Collins & Cox, 2014), disabled individuals' usage of the virtual world Second Life (Kleban & Kaye, 2015), leisure choices made in response to periods of high job strain (Petrou & Bakker, 2016), the role of physical activity to facilitate stress coping and well-being (Kim & McKenzie, 2014), and using leisure to develop resilience to stress (Denovan & Macaskill, 2017a, 2017b).

Iwasaki and Mannell's (2000) hierarchical model of leisure stress coping was developed to explain the different ways that leisure can be used to help people cope with stress. The rationale for including Iwasaki and Mannell's (2000) model as a theoretical basis within this thesis was not for its explanative account of leisure stress coping, but to define a theoretical justification which establishes leisure and the motivation to engage in leisure as sociable phenomenon, that can be facilitative of psychosocial resources such as social support. The presence of the leisure coping beliefs and, more specifically, the leisure friendships sub-dimension of the model provides substantial precedence to suggest that individual's beliefs regarding socialisation opportunities as a function of leisure are a source of social support.

The application of Iwasaki and Mannell's (2000) model in this manner contributes to the originality of the research that is presented within this thesis. By establishing that many believe and purposefully use leisure as a means of eliciting social support this provides the theoretical basis to associate (sociable) computer game play as being facilitative of social support and thereby, potentially useful as a therapeutic tool for the purpose of facilitating positive health-related behaviour change through the mechanisms identified later within this literature review.

2.4. Social support

Social support was defined by Cohen and Syme (1985) as resources that are provided by other persons. Previously Cobb (1976) described social support as information that leads individuals to believe that they are cared for, valued, and belonging to a social network of communication and mutual obligation. Social support can be provided by a broad range of sources such as family, friends, or community contacts such as social and religious groups (Salovey & Rothman, 2003).

Social support is commonly considered to be a multi-dimensional construct where each dimension has specific functional properties and includes emotional support, tangible support, informational support, and companionship support (Straub, 2001). These identified dimensions of social support are similar to those put forward by Iwasaki and Mannell (2000) in their leisure stress coping model; however, the authors identify a distinction between emotional support, which is provided to show care or thoughtfulness, for example, and esteem support, which specifically describes the bolstering of self-esteem or self-respect through social support.

In addition to the functionally distinct dimensions of social support, the construct can be considered to have two differing mechanisms in how social support can be received by an individual either being perceived social support or received social support (Barrera, 1986; Coleman & Iso-Ahola, 1993; Taylor, 2011). Perceived social support is the perception that an individual is loved and cared for, and can rely upon others for assistance when and where necessary. Received social support can be described as the actual transference of support whether through information, reassurance, or physical aid.

When measuring social support, typically either the structure of socially supportive networks (social integration) or their function is assessed. Social integration is concerned with the number of social relationships that an individual is involved with and the structure of interconnections among others within the network. The specific functions of support provided by others is investigated when measuring function support and is typically assessed in the context of receiving support in a particular scenario such as exposure to a stressor (Wethington & Kessler, 1986). Perceived and received social support appear to differ in their effects on health, which is discussed in section 2.4.3.

2.4.1 Leisure and social support.

As initially described, Iwasaki and Mannell's (2000) hierarchical model of leisure stress coping was developed to provide a framework to better understand how leisure-related beliefs and behaviours can be used to facilitate stress coping as depicted in Figures 2.1.-2.4. The association between leisure and social support that is highlighted in the leisure friendships sub-dimension of leisure coping beliefs and its associated components as well as the leisure coping strategies sub-

dimension leisure companionship are of significant interest and will be further explored in this section.

Leisure is widely considered to be often a social phenomenon that helps friendships to manifest between people (Iso-Ahola & Park, 1996), often being organised around social circles such as friends or familial groups, for example. Coleman and Iso-Ahola (1993) as well as Iso-Ahola and Park (1996) hypothesise that because leisure is sociable in nature it is capable of facilitating social support. Their suggested mechanism that this occurs is that by engaging in a leisure pursuit that is conducive to social interaction it becomes possible for those involved to develop friendships and social networks. The stronger the friendships become and the more embedded into the community (the social network) an individual becomes, the more likely they are to perceive that they would be supported by others in the group should the need arise. This explanation supports findings that suggest that people choose to engage in leisurely pursuits purely for socialisation purposes and the benefits that the social process yields (Iannotti, et al., 2013; Iso-Ahola, 1989).

Beard and Ragheb (1983) developed the leisure motivation scale to measure individual's motivations to participate in leisure, which is often used in leisure motivation research. In developing their scale, four factors of leisure motivation were identified that are associated with certain behaviours or expectations that a leisure activity can facilitate. The four factors of leisure motivation are entitled intellectual, social, competence-mastery, and stimulus-avoidance. The intellectual factor encapsulates motivations for leisure where mental stimulation can occur such as learning or problem-solving. The social factor represents a motivation to seek interpersonal relationships with others within a leisure pursuit. The

competence-mastery factor explains leisure motivation might be expressed as desires for competition and/or challenge to master the activity at hand. The stimulus-avoidance factor represents motivations for leisure engagement as an opportunity to remove oneself from over-stimulating situations, such as those that cause stress or anxiety.

Iwasaki and Mannell's (2000) hierarchical model of leisure stress coping and the supporting literature reviewed in this section subsequently suggested that the facilitation of perceived and tangible social support is a distinct motivation for individuals to engage in leisure. The next section examines the potential for sociability in computer games, that is, their ability to facilitate simultaneous play between individuals who are geographically co-located or, if not co-located, through internet networking technology (Buchanan-Oliver & Seo, 2012; Seo, Buchanan-Oliver, & Fam, 2015).

2.4.2. Sociability of computer games.

The inherent sociability of leisure and, by extension, the perceived and received social support that can be facilitated is of significant importance in leisure participation and is fundamental in the motivational process to engage in leisure. This association between leisure and social support leads to the initial step of the theoretical model that will shape the research presented in this thesis into the role that computer games may be able to play in encouraging positive health-related behaviour (see Figure 2.5.).

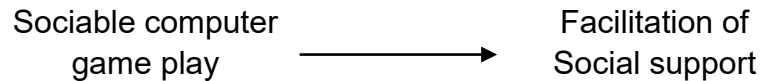


Figure 2.5. Initial step of the theoretical model highlighting expected increases of social support following participation in sociable computer game play.

The capacity for computer games to act as conduits for the facilitation of social support in computer game players is widely supported by research, typically suggesting that the perception of receiving social support is a strong motivation for engaging in computer game play. Several studies have aimed to develop taxonomies to identify and define different types of computer game player often, which have found evidence to support socially-driven motivations to play as well as socially-orientated playing behaviours (Park, Song, & Teng, 2011; Westwood & Griffiths, 2010; Williams et al., 2008; Yee, 2006a, 2006b). Examples of the factors that have been commonly identified include motivations to play for relationships, adventure, escapism, relaxation, and achievement (Park et al., 2011), achievement, relationship, immersion, escapism, and manipulation (Yee, 2006a), achievement, social, and immersion (Yee, 2006b), and sociability, achievement, and immersion (Williams et al., 2008).

Additionally, other research further qualifies the sociable motivational draw of computer game play by explaining that individuals elect to play computer games in order to meet people, form relationships, and to strengthen real-world relationships (Williams et al., 2006). Individuals are more likely to engage in longer computer game play sessions when playing sociably (Ducheneaut & Moore, 2006; Jansz & Tanis, 2007). More specific results were presented by Yee (2006a), who collected data from 30,000 MMORPG users and found that 39.4% male and 32% female respondents rated their relationships and friendships developed from MMORPG

play to be comparable or greater than that of their real-life friendships. Cole and Griffiths (2007) supported Yee's (2006a) findings with a sample of 912 self-selected players of MMORPGs from 45 countries which indicated that three quarters of males and females developed friendships through their gaming experiences, representing an average of 7.7 and 3.1 friendships for males and females, respectively, and that 26.3% of their sample indicated playing with family and real-world friends regularly. Therefore, Cole and Griffiths (2007) conclude that social interaction in MMORPGs is a considerable element in the enjoyment of playing this type of game.

Longman et al. (2009) highlighted the importance of sociable computer game play especially in online computer games. They found that game engagement, time spent playing, playing with familiar people, and membership of a social group, were significantly associated with higher levels of in-game social support. To clarify, Charlton (2002) identified the following factors, using factor analysis, as indicative criteria of game engagement: cognitive salience, the activity being prominent in a person's mental life; euphoria, the gaining of a 'buzz' or a 'high' from the activity; and tolerance, the need to engage in the activity to a progressively greater extent to acquire the same 'buzz'.

Longman et al.'s (2009) findings are of further interest as it was also found that higher in-game social support was significantly associated with fewer negative psychological symptoms such as depression, stress, and anxiety. The study made a distinction between high-use and low-use gamers and found that those in the high-use group received less offline social support than their counterparts in the low-use group and vice-versa for in-game social support. It is difficult to establish causality in this instance and it is therefore unclear if people with low social

support tend to play for longer and consequently gain in-game social support or if longer duration computer game playing leads to reduced offline social support. Reinecke (2009a, 2009b) suggested that computer games, especially online-based games, could act as significant sources of social support for those who lack it and would therefore act as a strong motivator to play. The claim that computer games can be facilitative of social support has been widely reported in both quantitative (Perry et al., 2018; Trepte, Reinecke, & Juechems, 2012), qualitative (O'Connor, Longman, White, & Obst, 2015), and mixed-method investigations (Dengah, Snodgrass, Else, & Polzer, 2018) and appears possible regardless of whether playing with friends who are known in real life, online only, or potentially strangers.

Further literature highlights the importance of the role that game design can have to influence and facilitate opportunities for sociable play and experiences to occur during game play. Lindley, Couteur, and Bianchi-Berthouze (2008) reported social interaction between pairs of players of a computer game increased significantly when interacting with the computer game using motion-based input as opposed to standard controller input. This increase in social interaction was not found to detract from engagement with the computer game, but instead increased it when bodily movement was used as the primary input for game play.

Competitive and cooperative computer game play may also have differing outcomes on the players involved. Staiano, Abraham, and Calvert (2013) conducted a 20-week intervention involving daily (weekdays) 30–60 minute periods of either cooperative or competitive exergame play in pairs. Results indicated that both the cooperative and competitive participant conditions experienced increased peer support. However, cooperative condition participants

experienced statistically significant reductions in weight and increases in self-efficacy, suggesting that cooperative computer game play might be more facilitative of certain outcomes than competitive computer game play.

The genre of a computer game might also impact psycho-social outcomes; as, previously, described by Smith (2006) the genre of a computer game can be associated with expected game mechanisms and features. Sherry, Lucas, Greenberg, and Holmstrom (2013) found that in 8th- and 10th-graders' motivations to play strategy computer games were playing for competition, arousal, and social interaction, but had different motivations for playing games of a simulation genre such as playing for challenge.

Mueller and Gibbs (2010) highlight the inherent differences between parallel and non-parallel computer game play. In a parallel computer game each player performs their actions independently and are inconsequential to other players as there is no ability to interfere with one another; this means that the difficulty of the task faced by their opponents cannot be influenced. In a non-parallel computer game at least one player creates or functions as an obstacle that an opponent must overcome in the pursuit of the computer game's goals. Non-parallel computer games involve concepts of offensive and defensive actions during game play in which an offensive action would be a direct attempt to attain the game's goal, potentially by overcoming the opponent, and a defensive action would be attempting to prevent the opponent from attaining the game's goal (Mueller, Gibbs, & Vetere, 2008). Mueller and Gibbs (2010) were interested in understanding how to facilitate social play in physically exertive computer games and developed 'Table Tennis for Three' which is a computer game that players interact with using bodily movement for three simultaneous players in geographically distinct

locations. They found that 'Table Tennis for Three' possessed both parallel and non-parallel game play elements and that participants used these properties of the game to enhance their gaming experiences and consequently engaged sociably with the other players.

Macvean and Robertson (2013) studied the use of an Iphone-based augmented reality exergame 'iFitQuest' with children during physical education classes over a seven-week period to determine if such technology could be used to increase the proportion of time participants spent engaging in moderate- and vigorous-intensity physical activity. The computer game system involved eight different game types that were played in the real-world and used GPS technology, enabling real-world movement to control an in-game avatar. The goals of the games ranged from collecting in-game objects or evading non-player characters which required real-world movement to achieve. As such, the 'iFitQuest' computer game activities were all single-player; however, many of the participants began to play the games sociably by comparing accumulated points with each other, socialising whilst playing, and engaging in competition. The sociable interaction between the children during their use of the 'iFitQuest' computer game supports the claims made by Stenros et al. (2009) that even single-player computer games can be considered to be sociable due to certain design elements in a game such as scoring/point systems that can stimulate conversation, comparison, and competition between players. This study is pertinent to the research presented in this thesis as it provided insight into the motivations of 'iFitQuest' users and their game-play decisions, such as difficulty setting used, game modes chosen, self-set goals, and sociable playing. The duration of the study, seven weeks, provides

useful information that can be used to develop other intervention strategies for facilitating positive health-related behaviour.

2.4.3. The impact of social support on health.

There are two principal hypotheses that address the links between social support and health. These are the buffering hypothesis and the direct-effects hypothesis (Stansfeld, 2006). The buffering hypothesis states that social support acts to buffer an individual from the deleterious effects of stressful life events by acting as an exploitable resource. In contrast, the direct-effects hypothesis suggests that social support improves health in general regardless of exposure to stress and that individuals with higher levels of social support are typically in better health than those with lower levels of social support. As such, the main distinction between the buffering hypothesis and the direct-effects hypothesis is the circumstances in which they state social support to be actively benefitting the individual either at all times according to the direct-effects hypothesis or, according to the buffering hypothesis, in response to a stressor (Taylor, 2011).

Support for these hypotheses has been published, with reports that the hypothesised stress-buffering function of social support has been found to occur across a range of scenarios. Such scenarios include buffering from the negative effects of stress in Mexican university applicants with familial support playing a unique role (Raffaelli et al., 2013), buffering patient's distress following renal transplantation (Pisanti et al., 2014) and also buffering from stressful outcomes following injury in athletes such as restlessness, isolation, and feelings of being cheated (Mitchell, Evans, Rees, & Hardy, 2014).

Conversely, support for the direct-effects hypothesis has been documented in Bekele et al. (2013) who found that social support had direct effects on physical health and mental health summary scores in people living with HIV/AIDS therefore, suggesting a benefit to health-related quality of life, regardless of depressive symptoms. Graham and Barnow (2013) found that higher levels of family support as well as friend support, but not partner support, was associated with higher levels of well-being. However, it was found that partner support was associated with a buffering effect on the relation between stress and well-being. Freeman and Rees (2010) investigated whether perceived social support from teammates in university athletes had direct and stress-buffering effects on self-confidence. All four dimensions of social support (emotional, esteem, informational, and tangible) had a direct and predictive effect upon self-confidence. Emotional, esteem, and informational support were also found to have stress-buffering effects on self-confidence.

The beneficial impact that social support has upon physiological health outcomes has long been researched. Associations between lower levels of social support and mortality have been identified. For example, Berkman and Syme (1979) conducted a nine-year study measuring the relationship between social and community ties and mortality in 6,928 adults living in California. It was found that individuals who reported lower levels of social integration were more likely to have died by the end of the study period. This association was found to be independent of self-reported physical health statuses such as socioeconomic status, smoking and alcohol consumption behaviour, obesity, and physical activity. Subsequent studies have been conducted controlling for baseline health status in participants which show that individuals with larger quantities and quality of social relationships

consistently are at less risk of premature death (Herbst-Damm & Kulik, 2005; Seeman, 1996). This is especially apparent in patients with cardiovascular disease (Brummet et al., 2001; Rutledge et al., 2004). House, Landis, and Umberson (1988) concluded that social support is a significant predictor of health and longevity, with an equivalent beneficial effect size to those of smoking, blood pressure, obesity, and physical activity, and that social isolation is a major risk for early mortality.

The impact that social support has upon mental-wellbeing outcomes is well-established with evidence identifying associations between social support and reduced psychological distress specifically in terms of depressive symptomatology and anxiety (Jacobson, Lord, & Newman, 2017; Lin, Ye, & Ensel, 1999; Rodebaugh, Lim, Shumaker, Levinson, & Thompson, 2015). Social support has been associated with the facilitation of psychological adjustment to chronically stressful conditions such as HIV for example (Turner-Cobb et al., 2002).

Uchino (2009) describes that the distinction between perceived and received social support is important to consider in the study of social support's role in benefiting health. Figures 2.6. and 2.7. depict the potential mechanisms in how perceived support and received support influence the stress-health relationship respectively.

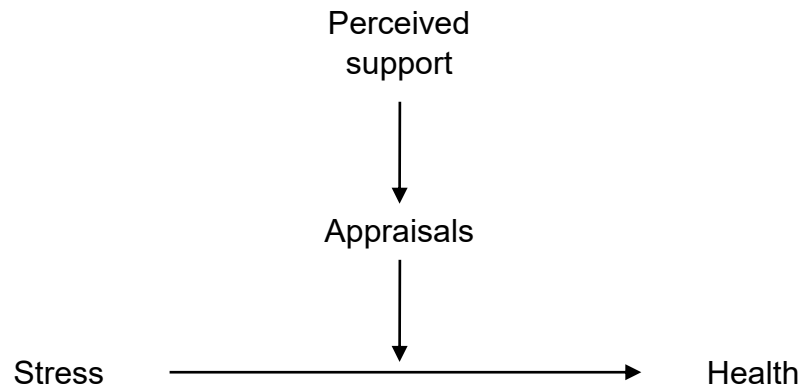


Figure 2.6. Perceived social support mechanism of influence on the stress-health relationship. Adapted from Lakey and Cohen (2000).

The diagram in Figure 2.6. suggests that beliefs in the availability of social support influences the appraisal of stressful situations, which buffers the effects of stress on health outcomes. Alternatively, received social support is depicted in Figure 2.7. as influencing the stress-health relationship by enhancing coping performance thereby, mitigating the impact of stressful events on health.

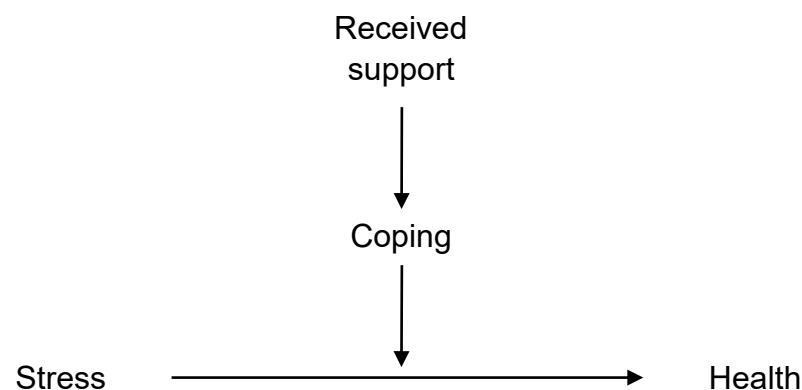


Figure 2.7. Received social supports mechanism of influence on the stress-health relationship. Adapted from Lakey and Cohen (2000).

There is evidence to suggest that perceived social support has a greater effect upon the stress-health relationship than received support does and has been more consistently associated with beneficial health outcomes (Uchino, 2009).

Wethington and Kessler (1986) state that the hypothesis that social relationships buffer people against stress has limited evidence to support it. However, perceived

support availability has been consistently demonstrated to buffer individuals from the deleterious effects of stress on psychological outcomes. Wethington and Kessler (1986) supported this claim with their findings suggesting that the stress-buffering effect of social support is more strongly associated to the perception of social support rather than to the effects of supportive behaviours (received social support).

There are some explanations as to why received social support may not be as effective as perceived social support in facilitating a beneficial impact upon health. For example, received social support has been documented to be unhelpful or potentially harmful in certain situations, for example by offering support or advice that may be interpreted to be minimizing a difficult situation. Additionally, the action of asking for help has been associated with a reduction in self-esteem in western populations suggesting that individualistic cultural expectations may influence the procurement of social support (Nadler & Fisher, 1986). Consequently, it is suggested that such a reduction in self-esteem may potentially mask or offset any tangible benefits associated with the receiving of social support (Uchino, 2004). The seeking of social support may also be discouraged in collectivist orientated cultures such as that of Asia as a means of maintaining group harmony (Taylor et al., 2004).

2.4.4. Social support, self-efficacy, and health behaviour.

Social support has a distinct role in the adoption and maintenance of positive health-related behaviours. This is reflected by its inclusion in a broad range of stage-based behaviour change models such as the prototype/willingness theory (Gibbons, Gerrard, Ouellette, & Burzette, 1998), and the transtheoretical model

(Prochaska & DiClemente, 1983). In the case of the theories of reasoned action (Ajzen & Fishbein, 1980) and planned behaviour (Ajzen, 1991), social norms are included in these models as a determinant of behavioural intention and, in turn, actual behaviour. Arguments supporting the replacement of social norms with social support as a more effective determinant of behaviour uptake have been put forward with supporting evidence showing this to be the case (Cavallo et al., 2014; Courneya & McAuley, 1995; Courneya, Plotnikoff, Hotz, & Birkett, 2000; Lee, Bowen, Mosley, & Turner, 2017; Wankel et al., 1994). Social support is also included in non-stage-based behaviour change models such as the health belief model (Maiman & Becker, 1974). Often, social support is included in such models to explain that the individual uses social norms or societal cues to inform their behaviour and, by extension, their health behaviour decision-making.

Engagement in leisure has been demonstrated to be a potential source of social support (see Sections 2.3.3., and 2.4.). There is strong evidence to associate social support with positive-health outcomes. For example, Chang (2017) found that the receiving of leisure social support as well as the provision of leisure social support was associated with a reduction in perceived stress. However, can leisure-derived social support, from computer game play, for example, be used to facilitate positive health-related outcomes as depicted in Figure 2.8?

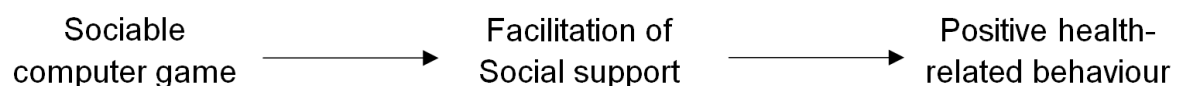


Figure 2.8. Proposed impact on social support from sociable computer game play and the consequential effect of social support on health.

This has been investigated in a number of studies such as Collins and Cox (2014), who investigated the capacity of computer games in facilitating recovery to avoid work-related strain and found that online social support, facilitated through the

development of online game-relationships, mediated the relationship between computer games play, and recovery. These findings are similar to those of Reinecke (2009a, 2009b) who investigated computer game play to facilitate recovery, but found that the recuperative effect of computer games was more prominent in those with lower levels of social support. This research suggests that the relationship between computer game play and recovery from work-related fatigue was moderated by social support. Collins and Cox's (2014) work might suggest that individuals may choose to engage in computer game play in order to supplement their own social support by engaging with other players.

It seems that computer games can indeed be a source of social support (Cole & Griffiths, 2007; Collins & Cox, 2014; Dengah et al., 2018; Ducheneaut & Moore, 2006; Jansz & Tanis, 2007; Lindley et al., 2008; Longman et al., 2009; Macvean & Robertson, 2013; Mueller & Gibbs, 2010; O'Connor et al., 2015; Park et al., 2011; Perry et al., 2018; Reinecke, 2009a, 2009b; Staiano et al., 2013; Stenros et al., 2009; Trepte et al., 2012; Westwood & Griffiths, 2010; Williams et al., 2006; Williams et al., 2008; Yee, 2006a, 2006b). However, this relationship between computer game play, social support and improved health/wellbeing can be further expanded upon with the inclusion of self-efficacy.

2.4.4.1. Self-efficacy.

Self-efficacy is of relevance in behaviour change research as it represents an individual's perceived ability in themselves to engage in a task to achieve intended or desired outcomes (Bandura, 1977). Self-efficacy represents the belief that one possesses the ability to resist temptation that would otherwise lead to failure, cope with situational stress, and be capable at deploying one's skills, qualities, or

knowledge to meet the demands of the situation. As such, self-efficacy plays an important role in human behaviour, especially so, in the case of health behaviours where self-efficacy beliefs determine whether health-related behaviour change will be initiated, the length of time it will be maintained for (and the energy to be expended), perseverance through adversity, and consequently, effects the chance of relapse occurring (Luszczynska & Schwarzer, 2005).

Self-efficacy has been investigated extensively in relation to a broad range of health behaviours including in behavioural intention, initiation, maintenance, and barriers to behaviour. Examples of such investigations include male HPV vaccination where self-efficacy predicted intention to be vaccinated (Fernandez, Amoyal, Paiva, & Prochaska, 2016), and healthy eating in Chinese adolescents in which self-efficacy better predicted healthy eating than attitudes towards the behaviour and societal norms (Chan, Prendergast, & Ng, 2016). Sheeran et al. (2016) conducted a meta-analysis of 204 studies that involved random assignment to treatment or control conditions which identified that experimentally induced changes in behavioural attitudes, norms, and self-efficacy are associated with medium-sized effects on changes in behavioural intention and small to medium-sized effects in behaviour-uptake (actual behaviour). A strength of this meta-analysis is that it consisted of papers that covered a broad range of behaviour due to the authors using Gochman's (1997) specification of health behaviours as overt behavioural patterns, actions, or habits that relate to health maintenance, health restoration, and health improvement. As such, a sample of the behaviours investigated in the papers that populated this meta-analysis include, but are not limited to, physical activity; smoking cessation; condom use; and blood donation.

The above evidence suggests that self-efficacy, in addition to social support (see Sections 2.4.3. and 2.4.4.), has demonstrable beneficial effects upon health. However, further investigating the mechanisms between social support, self-efficacy, and health may produce a more complex relationship than the basic causal relationship depicted in Figure 2.9., which is explored in Section 2.4.4.2.

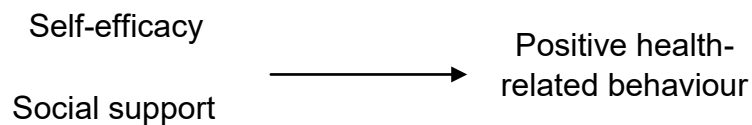


Figure 2.9. Beneficial effects of self-efficacy and social support upon health.

2.4.4.2. The association between social support and self-efficacy.

Self-efficacy and social support appear to be associated, in that a presence of social support may bolster the perception of self-efficacy in individuals. Bandura (1997) theorised that the adoption of new behaviours is strongly associated with perceived self-efficacy and that such self-efficacy could be bolstered through social modelling or vicarious experiences, behaviours that would typically be considered as social support such as instrumental (tangible), informational, emotional, and esteem support.

Resnick et al. (2002) suggest that self-efficacy and social support are associated by social support modifying the appraisal of behaviours through sociable activities, potentially through encouragement or informational support. In their study of 74 older adults living in care, it was found that social support (from friends) indirectly influenced exercise behaviour through self-efficacy expectations mediating the relationship. Supporting this, Duncan and McAuley (1993) conducted a study designed to increase physical activity in sedentary adults and found a similar relationship between social support, self-efficacy, and exercise. The association

between self-efficacy and social support in behavioural outcomes is not limited to physical activity. Faridvand, Mirghafourvand, Malakouti, and Mohammad-Alizadeh-Charandabi (2017) found in a sample of 220 Iranian mothers that social support was significantly associated with self-efficacy to breastfeed which predicted the likelihood to attempt breastfeeding, the likelihood of maintaining breastfeeding, and response to difficulties.

Therefore, the association between social support and self-efficacy builds upon the initial step of the theoretical model (Figure 2.5.) that highlighted an expected increase in social support following sociable computer game play. As such, the second step of the theoretical model that shapes this thesis' investigation into the role that computer games may be able to play in encouraging positive health-related behaviour change is depicted in Figure 2.10. The second step of the theoretical model highlights an association between social support, derived from sociable leisure engagement, and self-efficacy, as supported by Bandura (1997), Duncan and McAuley (1993), Faridvand et al. (2017), and Resnick et al. (2002).

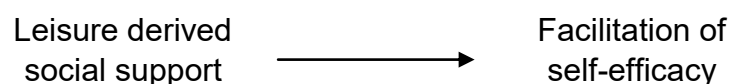


Figure 2.10. Second step of the theoretical model, which highlights the facilitation of perceived self-efficacy after exposure to leisure derived social support.

Therefore, social support and self-efficacy have both been identified as contributors to positive health outcomes (Figure 2.9.) and of social support facilitating perceptions of self-efficacy (Figure 2.10.). Rather than a causal relationship existing between social support, self-efficacy, and positive health outcomes an indirect relationship is suggested instead between social support and positive health outcomes, which is mediated by self-efficacy.

Self-efficacy has been identified as a mediator in a number of studies that associate social support with a range of behavioural outcomes. Ernsting, Knoll, Schneider, and Schwarzer (2015) investigated the uptake of a workplace flu vaccination programme and identified that social support was associated with vaccination, which was mediated by self-efficacy. The model was extended to include two sequential mediators: first, self-efficacy and, second, planning (knowledge of when and where to be vaccinated), which resulted in full mediation. Zhang and Huang (2018) found that career decision-making self-efficacy mediated the relationship between career-related peer social support (peer role models) and career exploration (identification of career goals and pursuit of career information). Rackow, Scholz, and Hornung (2015) conducted an eight-week study in which participants found and exercised with a new exercise companion. It was found that received emotional social support positively predicted self-efficacy, self-monitoring, and action planning. In turn, self-monitoring and self-efficacy, but not action planning, predicted frequency and duration of exercise. The mediating role of self-efficacy contributed to a significant indirect effect whereas, the indirect effect of action planning and self-monitoring were not found to be statistically different from zero.

Thomas, Muralidharan, Medoff, and Drapalski (2016) investigated the association between social support and objective recovery (social functioning and symptoms) and subjective recovery (feelings of empowerment, hope, optimism, and perceptions of self) in a sample of 250 U.S. veterans with serious mental illnesses. A series of mediation analyses were performed which included social support network size, satisfaction with social support, and perceived support from the mental health system as predictors, self-efficacy as the mediator, and objective

and subjective recovery as the outcomes. Full mediation occurred when social support network size was included with the objective and subjective recovery outcomes, and when perceived support from the mental health system was included with the objective recovery outcome. Partial mediation occurred when satisfaction with social support was included with the objective and subjective recovery outcomes, and when perceived support from the mental health system was included with subjective recovery.

Maeda, Shen, Schwarz, Farrell, and Mallon (2013) investigated 252 heart-failure outpatients and found that self-efficacy fully mediated the association between social support and depression with treatment adherence. The authors suggest that future interventions should aim to facilitate increased social support and self-efficacy in heart-failure patients, as depressed patients are three times less likely to adhere to treatment regimens. Wang et al. (2015) found that in a sample of 222 patients with central-nervous system tumours and PTSD, self-efficacy partially mediated the relationship between social support and PTSD symptomology, suggesting that higher self-efficacy resulted in fewer PTSD symptoms.

This suggests that in a broad range of health outcomes, social support is associated with health and that the relationship is mediated by self-efficacy (Figure 2.11).

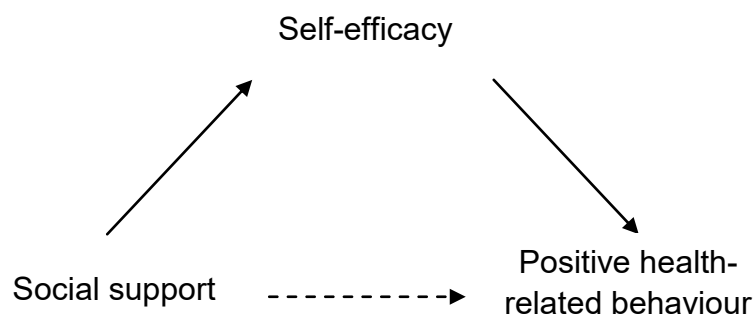


Figure 2.11. Relationship between social support and health, mediated by self-efficacy.

2.5. Summary

A number of studies have identified the importance of social support and self-efficacy in promoting positive health-related behaviours, such as in adherence to drug treatments or exercise, as well as their capacity in reducing the occurrence/perception of negative symptoms of illnesses as well, such as in sufferers of PTSD. The precise mechanisms of action that social support and self-efficacy have upon health outcomes has been widely investigated, in which self-efficacy mediates the relationship between social support and health.

According to Iwasaki and Mannell's (2000) hierarchical model of leisure stress coping, a substantial motivation for the pursuit of and engagement in leisure activities is for the purpose of gaining social support. The application of this model to computer games technology identifies computer games to be a potential focal point for sociable activity and therefore, may act as a readily available source of social support. The significance of this is the nature of computer games in the UK being a well-established and accepted form of media entertainment in which a large proportion of the population regularly engages in.

Therefore, the social support that may be accessible through sociable computer game play could, in turn, be facilitative of positive health outcomes. This mechanism is theorised to be mediated by the positive effect of self-efficacy, which has been facilitated by social support from sociable computer game play (Figure 2.12.).

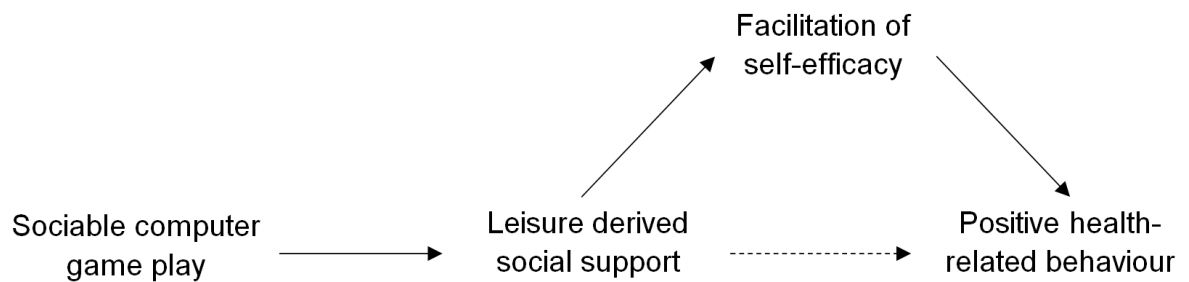


Figure 2.12. Research model.

Figure 2.12., represents the crux of the present thesis' contribution of knowledge to the field of health psychology. Specifically, the original contribution to knowledge involves the novel application of Iwasaki and Mannell's (2000) hierarchical model of leisure stress coping to expound the capacity for sociable computer game play to facilitate social support and thereby encourage positive health-related behaviour change through the model depicted in Figure 2.12. This is an original arrangement of concepts aimed to justify the use of sociable computer game play as a therapeutic tool by facilitating improved health outcomes within the general public, through means of increasing physical activity engagement and reducing perceived stress. In developing more efficacious treatment interventions for these two behavioural outcomes health psychology can help to prevent the occurrence of physical inactivity and stress related illnesses. Such illnesses at present are responsible for significant costs to healthcare through treatment and rehabilitation as well as the UK economy in general through loss of earnings and costs to businesses. As such, establishing that a technology such as computer games as having the potential to be used as a therapeutic tool in increasing adherence to physical activity guidelines and/or reducing the perception of stress would provide a tool that is already distributed widely within the domestic environment and that is readily affordable by the general public.

2.5.1. Research aims.

The following research aims have been formulated to describe the general intentions of the research contained within this thesis.

Research Aim 1: to investigate the capacity for computer games, through sociable game play, to elicit social support, self-efficacy, and positive health-related behaviour.

Research Aim 2: to investigate if sociable computer game play can be used as a therapeutic tool across a range of health outcomes.

Research Aim 3: to investigate the mechanisms of action on positive health-related behaviour from social support and self-efficacy.

2.5.2. Research questions.

Subsequent to the described research aims, the following research questions have been formulated to guide experimental investigation in testing the proposed mediation model depicted in Figure 2.12.

Research Question 1: does sociable computer game play have the capacity to facilitate social support?

Research Question 2: does social support, potentially facilitated through sociable computer game play, in turn, facilitate self-efficacy?

Research Question 3: does self-efficacy mediate a relationship between social support, potentially facilitated through sociable computer game play, and positive health-related behaviour?

This thesis presents two separate quantitative studies and a third, smaller, qualitative investigation.

Study 1 - Chapter 3: sociable computer game play and increasing physical activity.

Study 2 - Chapter 4: sociable computer game play and reducing perceived stress.

Study 3 - Chapter 5: qualitative evidence.

Chapter 3 - Study 1

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3.1. Abstract - Study 1

Sociable computer game play was investigated for its capacity to be facilitative of engagement in physical activity by way of a mediation relationship predicted by social support and mediated by self-efficacy. The study design involved a group study condition requiring sociable computer game play, a solo study condition requiring solo computer game play, and a control study condition with no computer game play. A self-selected sampling strategy was used to recruit $N = 54$ (72.22% female; $M = 24.98$) allocated, quasi-randomly, in teams of two-to-four to the group study condition, or randomly to the solo, or control study conditions. Computer game play (Wii Sports) occurred for 30 minute periods on a weekly basis for eight weeks with measurement of social support (quantity and satisfaction), self-efficacy for exercise, and physical activity occurring after computer game play.

Analysis involved three-by-two (study condition by time point) mixed ANOVA and ANCOVA, which were supplemented with MBI, and mediation analysis. Mixed ANOVA revealed a significant interaction effect suggesting that the group study condition engaged more frequently in physical activity than the other study conditions. MBI indicated that mechanistically the group study condition was likely positive for social support (satisfaction), vigorous-intensity physical activity, and total physical activity, associated clinical inference indicated that for these outcomes the group study condition was clinically beneficial. ANCOVA revealed that at the end of the intervention the solo and control study conditions did not differ significantly in any of the outcomes. The group and solo study conditions differed significantly in the frequency of physical activity with the group study condition engaging in physical activity more frequently. MBI indicated that when comparing the solo and control study conditions for the self-efficacy outcome the

solo study condition was mechanistically likely positive and clinically inferred for use. Comparing the group and solo study conditions following ANCOVA, likely positive mechanistic inferences were made for social support (quantity), vigorous-intensity, total, and frequency of physical activity, each of which had associated clinical inferences recommending the intervention for use. Mediation analysis revealed three instances of indirect-only mediation, which were detected within the group study condition with social support (satisfaction) as the predictor.

Following mixed ANOVA, ANCOVA, and associated MBI, findings suggest that sociable computer game play was facilitative of social support (quantity and satisfaction) and increased quantity and frequency of physical activity engagement, whereas solo computer game play and no computer game play were not. Following mediation analysis, findings suggest that satisfaction with social support, self-efficacy for exercise, and physical activity are associated in a mediating relationship, which is predicted by satisfaction with social support and mediated by self-efficacy for exercise.

The application of Iwasaki and Mannell's hierarchical model of leisure stress coping is novel in theoretically establishing computer game play as a sociable activity and thereby facilitative of social support. This led to the unique arrangement of social support, self-efficacy, and physical activity in a mediation model. Furthermore, elements of the research design involving three study conditions provided the opportunity to establish that sociable computer game play rather than game play in general was facilitative of positive health-related behaviour. The use of MBI is unique within this area of health psychology and provided useful rich information beyond that typical of mixed ANOVA and ANCOVA.

3.2. Introduction - Study 1

3.2.1. Background.

The problems presented by physical inactivity are becoming increasingly burdensome to society. Physical inactivity has been associated with a number of health risks including breast and colon cancers, diabetes, heart disease, and obesity (WHO, 2018b). The WHO (2018b) ranked physical inactivity as the fourth leading risk factor for global mortality. Because of these associated health concerns, the global cost of physical inactivity was estimated to be \$67.5bn (£52bn) in 2013. The total economic impact of physical inactivity to the UK was estimated at \$1.7bn (£1.3bn), representing approximately 2.5% of the global cost, and consisting of sums of \$1.3bn (£991 million) in healthcare costs and \$400 (£305 million) in lost productivity (Torjesen, 2016).

On the other hand, engagement with physical activity yields a wide range of psychological benefits such as being effective at combating depression and anxiety (Cole, 2010; Cooney et al., 2013) as well as increasing psychological affect, wellbeing, optimism, and life satisfaction in individuals ranging from young adulthood to middle-aged (Edwards, 2006) and older adults (Kim, Chun, Heo, Lee, & Han, 2016). Furthermore, physical activity is a prominent contributor to physiological good health and wellbeing by helping to control and maintain weight by metabolising fat deposits, development of muscle mass, and reducing the occurrence of the diseases described earlier (Centers for Disease Control and Prevention, 2015).

It is not certain what the precise mechanism(s) are that facilitate physical activity induced benefits to health and psychological well-being. One proposed

neurobiological explanation suggests that the secretion of endorphins into the brain following exercise may explain exercise-induced highs. Dishman and O'Connor (2009) stated that after reviewing relevant animal and human studies it was plausible for endogenous opioids (endorphins, enkephalins, and dynorphins) secreted by engagement in physical activity could be associated with changes in mood. This may be due to endorphins having an active role in modulating dopaminergic neurons in parts of the brain that are involved with motivation and pleasure and as such could indirectly influence positive moods; however, there was little evidence to support this claim. Alternatively, protein synthesis and metabolism is considered to be an important mechanism of physical activity in the promotion of health. The production of trophic factors and neurotransmitters such as brain-derived neurotrophic factor and dopamine, respectively, through exercise can contribute to various brain responses including neurogenesis, angiogenesis, and synaptogenesis, essentially facilitating the development of neuro-generative, neuro-adaptive, and neuro-protective properties (Deslandes, 2014; Dishman et al., 2006). Despite the uncertainty regarding the precise mechanism(s) of action that physical activity produces to facilitate changes in health and well-being, there is compelling evidence however, that engagement in physical activity benefits physical and psychological well-being in differing populations and for a broad range of health concerns.

Presently, the WHO (2010) recommendations for the amount of physical activity that should be engaged in on a weekly basis is at minimum 150 minutes of moderate-intensity aerobic activity, which is defined as exercise that raises the heart rate and increases the frequency of respiration. Alternatively, 75 minutes of vigorous-intensity aerobic activity, which is defined as exercise that makes you

breathe hard and fast making it difficult to say more than a few words without needing to breathe is recommended. An equivalent combination of moderate- and vigorous-intensity aerobic activity can meet the WHO's recommendations.

Despite the extensively documented associated health concerns of physical inactivity some public health studies have found that approximately, one third of the global population do not engage in the recommended quantities of physical activity (Paech, Luszczynska, & Lippke, 2016). There appear to be geographical, economical, age, and sex factors at play that influence people's engagement in physically active activities. Research conducted by the British Heart Foundation (2015), using data collected within the UK in 2012, found that physical activity is more common in men and women who live in the south-east of England (14% of men and 23% of women physically inactive) and least common in the north-west (26% of men and 31% of women physically inactive). Furthermore, 76% of men and 63% of women in the highest quintile of income reached recommended levels of physical activity compared to 55% of men and 47% of women in the lowest income quintile. The effect of wealth upon participation in physical activity also appears to apply to adolescents as well, with less affluent families being less likely to have children meeting physical activity recommendations (Pearce, Jenkins, Kirk, & Law, 2008).

Age appears to be inversely related to levels of physical activity in both boys and girls with levels of physical activity declining as age increases. In 2012, 24% of boys and 23% of girls met age-appropriate recommendations for physical activity at ages 5–7; however, for ages 13–15 rates of meeting physical activity recommendations fell to 14% for boys and 8% for girls. Additionally, when comparing physical activity statistics recorded in 2008 with the 2012 data it

appears that physical activity has reduced for males and females of all ages, with the largest decline in physical activity being observed in the 13–15 years of age bracket for boys and girls (British Heart Foundation, 2015).

There are a number of reasons that may explain why individuals choose not to engage in sufficient quantities of moderate- and/or vigorous-intensity physical activity to meet the recommended guidelines or even to do any exercise at all despite the described health benefits that exercise offers. Research has indicated that the perception of a barrier to exercise is potentially responsible for physical inactivity; the barrier is seen as a reason or explanation for why an individual might choose to be physically inactive. Examples include, the perception of workplace barriers such as workload being too large to have time to exercise (Mazzola, Moore, & Alexander, 2017). In undergraduate students with sporadic or non-existent exercise habits physical exertion and time constraints were found to be perceived barriers (Grubbs & Carter, 2002). Overweight and obese individuals facing potential stigmatization within exercise settings, such as at the gym, acted as a barrier and led to unhealthy weight-loss practices, such as purging (Schvey et al., 2017).

Mailey, Phillips, Dlugonski, and Conroy (2016) looked at barriers to exercise in parents and concluded that efforts should be made to reduce the perception of such barriers as well as to improve confidence (self-efficacy) in overcoming them. This study was limited to investigating the perceived exercise barriers that parents face. However, their findings were consistent with other research testing social cognitive models of exercise on a variety of populations, including older married couples (Ayotte, Margrett, & Hicks-Patrick, 2010), college students (Rovniak, Anderson, Winett, & Stephens, 2002), and adult churchgoers (Anderson, Winett,

Wojcik, & Williams, 2010). As such, the recommended solutions that the authors made can be applied to other instances where barriers to exercise that hinder participation in physical activity may occur, such as different demographic populations.

It is conceivable, however, when considering the role that the perception of barriers to exercise can have is that it is difficult to determine how much social-desirability bias might influence perceived barriers. As active participation in exercise is a socially desirable activity it is plausible that individuals with no interest in physical activity indicate that they cannot exercise because of certain unavoidable factors/barriers (e.g., workload too large, insufficient free time, or childcare responsibilities) rather than wanting to exercise but legitimately not being able to due to their perceived barriers.

Hunter, Tully, Donnelly, Stevenson, and Kee (2014) posited a further potential explanation for why many do not engage in at least the minimum recommended quantity of physical activity based on a population survey of 4,653 adults in Northern Ireland. They suggest that a portion of the population are unaware of such physical activity recommendations. Their findings suggest that males with a lower level of education, who lived in more deprived areas, had a low income, and who did not actively engage in physical activity as well as women who were younger and reported poor health were more likely to be entirely unaware of physical activity guidelines.

3.2.2. Modifying behaviour to be more physically active.

Many studies have been published which document the importance of social support and self-efficacy in adopting new health benefiting behaviours such as exercise. For example, Brazilian adults receiving social support provided by both family and friends were three times more physically active than individuals who did not receive such support (da Silva, Azevedo, & Gonçalves, 2013). Similarly, Morrissey, Janz, Letuchy, Francis, and Levy (2015) found that an increase in social support provided by family and/or friends resulted in an increase in both moderate- and vigorous-intensity exercise in adolescents. Parental social support was found by Cheng, Mendonça, and de Farias (2015) to be associated with physical activity in adolescents and was indirectly mediated by self-efficacy.

Belanger and Patrick (2018) investigated if social support from particular sources was more or less beneficial to the adoption of physical activity behaviour in college students and, additionally, if the type of support made a difference or not. It was found that social support provided by family and friends was associated with physical activity behaviours. However, social support provided by friends yielded a stronger effect than did family sourced social support. Friends appeared to provide companionship support and higher levels of esteem support, which was positively associated with physical activity behaviours. Family-based social support provided higher levels of informational support, which was negatively associated with physical activity behaviours. This research suggests that individuals may look to receive social support from a number of sources depending upon what type of support is perceived to be needed at the time. It is, however, difficult to generalize these findings to a broader population. It is possible that college students may look to friends rather than family for their social support needs due to frequency of

interaction and convenience of proximity which may explain why friend-based social support was found to be more effective than family-based social support.

Corroborative with the findings of Belanger and Patrick (2018) that suggest particular groups may provide certain elements of social support, Mendonça and de Farias (2015) studied Brazilian adolescents. They found that the provision of social support that was associated with physical activity differed between friends and parents, but also differed depending upon the recipient's sex. Physical activity associated parental social support was found to consist of encouragement for female adolescents, but positive comments for male adolescents. Male adolescents benefitted from social support provided from friends engaging in mutual physical activity. Both male and female adolescents received social support in the form of positive commentary.

The mechanism of precisely how social support can facilitate engagement in physical activity and long-term adherence to it can be explained using social cognitive theory, which suggests that individuals can learn from other people (Edwardson, Gorely, Pearson, & Atkin, 2013). This sociable learning can occur through reinforcement behaviour in which encouragement is offered to the individual from others in the environment or alternatively, through observation and subsequent replication of behaviour by the individual. As such, the provision of social support can occur in various forms including emotional, motivational, instrumental, and informational support, and additionally support can be given either tangibly (provision of equipment or transportation for example) or intangibly (encouraging behaviour or information for example [Beets, Cardinal, & Alderman, 2010]).

A number of studies have been conducted that have attempted to modify, through intervention, physical activity level in a range of demographic populations such as adolescents and the elderly. The duration of these physical activity-facilitating interventions is highly variable, lasting as few as three weeks in the case of Fernández, Montenegro, Knoll, and Schwarzer (2014). They found that the effect that self-efficacy has on physical activity can be partially explained by action control, one's ability to control one's actions and focus, and that social support moderated the relationship between self-efficacy and physical activity, suggesting that higher levels of social support compensated for lower levels of self-efficacy.

Longer duration interventions include that of Quaresma, Palmeira, Martins, Minderico, and Sardinha (2014), which ran for 24 months and investigated the application of an intervention program that addressed personal, social, physical, and social environmental factors, within an ecological model, that are thought to be related to and to also influence physical activity and health. The intervention yielded statistically significant direct effects in improving social support and intrinsic motivation and statistically significant indirect effects on physical activity and quality of life, which were mediated, in serial, by parental or peer social support and intrinsic motivation.

Another example of an intervention-based study designed to facilitate physical activity is that of Eather, Morgan, and Lubans (2013) who used the 'Fit-4-Fun' physical activity program for primary school children. This involved an eight-week curriculum of lessons designed to improve understanding and skills that are necessary for short- and long-term physical activity behaviour change, and which was rooted in Bandura's social cognitive theory. Findings showed that social support provided by classroom teachers significantly mediated the effect of the

'Fit-4-Fun' intervention on physical activity. At six-month follow-up significant treatment effects were found for cardio-respiratory fitness, body composition, body mass index (BMI), flexibility, muscular fitness, and physical activity.

De Lacy-Vawdon et al. (2018) conducted a substantial review of program features that have been found to influence attendance and adherence to group-based physical activity by older adults which involved data from eight quantitative and 13 qualitative studies published between 1995 and 2016 and included participants over the age of 55. Both the quantitative and qualitative studies identified social factors as being relevant to engaging in and adhering to group-based physical activity. This was due to companionship being seen as motivational as well as socialising opportunities revolving around events that require physical activity to participate in. The authors identified that communalities between participants were conducive to facilitating a socially supportive network such as sharing customs and traditions, language, interests, and religion.

3.2.3. Increasing physical activity through leisure.

Leisure time represents an excellent opportunity in which to encourage the uptake and adherence to physical activity. This is primarily due to the relative absence of opportunity to be physically active during other times of the day such as at work/school, sleep, and mealtimes.

As such, the association between social support and leisure related physical activity is of interest to researchers such as Chia-Yuan, Su-I, and Miller (2018) in a study of 7,714 U.S. elderly individuals. They found that, when living alone, older adults were more likely to report lower levels of social support and less leisure-time physical activity. Corroborating these findings Böhm, Mielke, da Cruz,

Ramires, and Wehrmeister (2016) studied elderly individuals in Brazil and found that the prevalence of elderly persons reaching the recommendations of physical activity was 18.4%. Those who had the company of family or friends during recreational walking were 2.45 times more likely to reach physical activity recommendations and those who had the company of friends during moderate-to-vigorous-intensity physical activity were 3.23 times more likely to reach recommendations for physical activity. Similar findings associating social support with recreational physical activity have been identified with other populations including Brazilian physical education undergraduates (Kollerde Paiva, de Camargo, de Paula da Silver, & Siqueira Reis, 2016), Latino women (Soto et al., 2018), and adults from the United States, Australia, Belgium (van Dyck et al., 2015), and from the UK (Kouvonen et al., 2012).

Cerin, Leslie, Sugiyama, and Owen (2010) investigated 2,194 Australian adults. They identified that perceptions of social support were effective at reducing perceived barriers, such as lack of motivation and time constraints, to participate in recreational physical activity. It was suggested that this may occur due to a re-evaluation in values and priorities. Recreational physical activity may be more highly prioritised when an individual has someone else to exercise with. Skowron, Stodolska, and Shinew (2008) identified social support as a significant predictor of recreational exercise amongst Latino women. Corroborative with de Lacy-Vawdon et al. (2018), the importance of social modelling was also identified. It was found that participants who indicated rarely seeing other Latino women exercising were, in turn, less likely to exercise recreationally themselves.

Peterson et al. (2008) investigated American adults with mild-to-moderate intellectual disabilities including Down's syndrome, cerebral palsy, and brain injury.

They identified a mediating association in older participants between social support sourced from peers, self-efficacy, and participation in recreational physical activity.

The described literature suggests that social support is an important factor in individuals choosing to partake in recreational physical activity during leisure time. As such, the development of leisure-based interventions that facilitate social support and physical activity seem a worthwhile avenue of further inquiry.

The emergence of exergames, computer games that include physical activity or movement as a primary form of interaction with the game, have led many researchers to investigate their capacity to facilitate physical activity. Choi et al. (2014) developed a sociable mobile phone based exergame to facilitate engagement in swimming for exercise. The goal in this exergame is to defeat an enemy, called the leviathan. This is done using swimming pull/push actions as inputs, which are detected by the exergame and correspond to in-game actions determined by the particular swimming stroke that is being performed. For example, freestyle is for attack, butterfly is for critical attack, breaststroke is for evasion, and backstroke is for healing. The game communicates information to the player audibly using a waterproof wired earpiece which projects sounds to the player that are associated with low player health, health of the leviathan, death of the player/leviathan, and the actions of teammates. Findings from interviews with participants who tested the exergame revealed that all participants enjoyed playing the computer game and that most of the participants reporting certain degrees of dissociation from swimming meaning that the focus was on playing the game rather than the monotonous activity of swimming for exercise. Furthermore, participants reported a socially enriching element of playing the computer game,

although the game did not support voice or visual communication between players. Experiences of bonding and team building were experienced due to the audible communication of each other's actions, allowing for strategies to be devised to win the game. Lastly, players reported that their swimming activity became more intense by engaging in more butterfly swimming stroke to take advantage of the extra damage it does to the leviathan over the less physically demanding stroke of freestyle.

Staiano and Calvert (2011) investigated the role of an exergame and its effect on calorific expenditure in low-income African-American adolescents. The study consisted of three participant conditions: solitary tennis exergame play for 30 minutes against computer-generated opponents, sociable tennis exergame play for 30 minutes against a real opponent, and no physical activity involving a sedentary computer task. As predicted, it was found that both of the exergame conditions expended more energy than the control group. However, adolescents within the sociable exergame condition expended comparable calories to actual tennis court play. The authors attribute this to the presence of competition; no consideration of the potential role of social support or self-efficacy is given.

There are a number of limitations in this study, firstly the only exergame available to play was that of tennis. As described by Iwasaki and Mannell (2000) and outlined within Chapter 2, an important component of the leisure experience is that of self-determination, the sense of control in one's actions. Limiting the available selection of games to one removes the element of choice and, consequently, the ability for participants to self-determine. Secondly, the sociable game play study condition involved participants competing with one-another in the tennis exergame, which may have been perceived as further restriction by participants

when collaborative or friendly competition may have been more desirable. Thirdly, there are issues regarding demand characteristics, as participants did not engage in computer game play by themselves, in the exergame condition, or with their opponents, in the sociable exergame condition, privately. A number of Wii consoles and televisions had been setup within a large university classroom meaning that participants could view the game play of other players, which may have influenced their own game play actions or, potentially, created an uncomfortable atmosphere due to embarrassment due to a lack of skill at playing the computer game, for example. Lastly, it is difficult to determine if the reported benefits to physical activity after exposure to the exergame can be maintained over a period of time longer than two weeks. It is possible that a novelty effect exists with the introduction of new technology such as the Nintendo Wii and that caloric expenditure may return to normal levels if/when boredom with the computer game occurs and, as such, experimental investigation over a longer period of time to ascertain this would be valuable.

Despite the limitations identified in Staiano and Calvert (2011), the computer game that was used within the study, Nintendo Wii Sports, offers a number of activities to players including tennis, bowling, golf, boxing, and baseball, thereby providing the opportunity for self-determination when playing, which as outlined by Iwasaki and Mannell (2000) is essential for achieving a leisure state. Nintendo Wii Sports has been extensively used within the psychological literature in assessing the energy expenditure capabilities of Nintendo Wii Sports' activities (Bausch, Beran, Cahanes, & Krug, 2007; Graves, Stratton, Ridgers, & Cable, 2007; Haddock, Siegel, & Wilkin, 2010) and their effectiveness in facilitating weight loss (Staiano et al., 2013). Other outcomes that have been investigated using Nintendo Wii Sports

include obstacle gait in elderly women at risk of falling (Dae-In, Daw-Sik, & Mi-Ae, 2015), arm function following stroke (Adie et al., 2017), pain relief of delayed onset muscle soreness following intensive exercise (Naugle, Parr, Sukyoon, & Naugle, 2017), physical and psychosocial function in residentially cared-for elders (Keogh, Power, Wooller, Lucas, & Whatman, 2014), and in a case study assessing manual dexterity and hand-grip strength in an individual with Becker muscular dystrophy (de Carvalho, Carrogi-Vianna, & Blascovi-Assis, 2014). Therefore, Nintendo Wii Sports appears to be a suitable computer game for use in the present research due to the above described opportunities that the game provides for self-determination of players and due to the extensive usage of this technology within the psychological literature.

3.2.4. The present investigation.

The research presented in this thesis is primarily interested in the role that social support and self-efficacy can play in modifying negative health-related behaviour into positive health-related behaviour. There is a particular interest in assessing and measuring the proposed mediating relationship between social support, self-efficacy and, in the present experiment, physical activity (see Figure 3.1.).

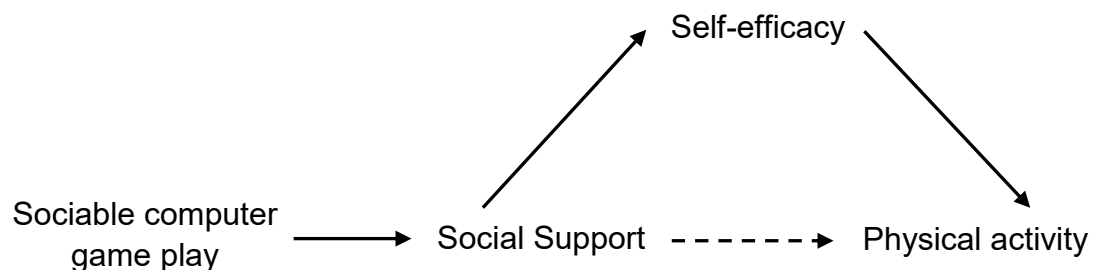


Figure 3.1. Proposed mediating relationship between social support (derived from sociable computer game play) and physical activity with self-efficacy mediating the relationship.

The present study uses sociable computer game play as a stimulus to facilitate social support in participants. It was expected that, if successfully facilitated, the

increase in social support would facilitate self-efficacy within participants, thereby providing the perceived capacity and confidence to engage in physical activity.

The postulation and supporting evidence that sociable computer game play can facilitate social support in individuals and in turn that social support contributes to an increase in self-efficacy is presented within the thesis introduction and literature review (Chapters 1 and 2).

As such, the study aimed to demonstrate that sociable computer game play facilitates measurable improvements to social support, self-efficacy, and physical activity engagement. A second aim of the study was to establish that it is specifically sociable computer game play, not simply computer game exposure, which facilitates social support and, in turn, self-efficacy, and physical activity. The third aim of the study was to test the proposed mediated relationship between sociable computer game play-facilitated social support and increasing physical activity with self-efficacy (facilitated by an increase in social support) as the mediator.

Therefore, the following nine hypotheses were devised to determine the effectiveness of an intervention that used sociable computer game play to attempt to facilitate social support, self-efficacy, and physical activity as well as to test for the proposed mediated relationship.

H_{1a}: Group activity increases social support over time more than solo activity does.

H_{1b}: Group activity increases self-efficacy over time more than solo activity does.

H_{1c}: Group activity increases moderate-and/or vigorous-intensity physical activity over time more than solo activity does.

H_{1d}: Group activity increases the frequency of physical activity over time more than solo activity does.

H_{2a}: Computer game play produces greater levels of social support when compared to no computer game play, but only when the computer game play is sociable.

H_{2b}: Computer game play produces greater levels of self-efficacy when compared to no computer game play, but only when the computer game play is sociable.

H_{2c}: Computer game play produces greater levels of moderate-and/or vigorous-intensity physical activity when compared to no computer game play, but only when the computer game play is sociable.

H_{2d}: Computer game play produces a greater frequency of physical activity when compared to no computer game play, but only when the computer game play is sociable.

H₃: Self-efficacy mediates the effect of social support on physical activity.

3.3. Method - Study 1

3.3.1. Design.

The present study used an experimental independent measures design; however, some non-random allocation to the study conditions occurred which will be explained further in the procedure (Section 3.3.4.). The independent variable was study condition and included three levels: group, solo, and control. Dependent variables were: (1) social support, (2) self-efficacy for exercise, and (3) physical activity.

3.3.2. Participants.

Fifty-two Teesside University psychology students were recruited using a self-selected sampling strategy; this was achieved using Teesside University's online research participation system in which prospective participants signed-up to timeslots appropriate to their own schedules. A further 13 participants were recruited opportunistically and were friends or family of the researcher. The following inclusion criteria were applied. First, participants must typically engage in less physical activity than what is recommended by health organisations such as the NHS and WHO. Current guidelines stipulate that individuals should attempt on a weekly basis to engage in 150 minutes of moderate-intensity aerobic activity or 75 minutes of vigorous-intensity aerobic activity (WHO, 2010). Participants were excluded from participation if they were active members of any group-based physical activity community. Individuals under the age of 18 years could not participate.

This sampling strategy resulted in the recruitment of $N = 65$, which consisted of 22 male (33.85%) and 43 female (66.15%) participants whose ages ranged between

18 and 53 ($M = 22.45$; $SD = 7.96$). They were distributed approximately evenly between the three study conditions (group, $n = 23$; solo, $n = 21$; and control, $n = 21$). A prospective power analysis indicated that in order to detect a large effect size $N = 63$ ($n = 21$) was required to achieve a power of 0.80, for a large effect size of $f = 0.40$, and with a significance level of 0.05 (the values of N and n have been increased by 10% to account for potential outliers and other eventualities). Descriptive statistical information regarding each condition are displayed in Table 3.1.

Table 3.1

Descriptive statistics of the sample by study condition

Condition	n	Sex		Age		
		Male	Female	Range	Mean	SD
Group	23	4 (17.39%)	19 (82.61%)	18–53	25.65	10.52
Solo	21	11 (52.38%)	10 (47.62%)	18–42	22.29	6.71
Control	21	7 (33.33%)	14 (66.66%)	18–38	25.35	5.18

Participants within the group study condition participated in ‘teams’ consisting of between two-to-four participants. As such, the group study condition consisted of eight distinct teams of participants who participated simultaneously with the other members of their team. Descriptive results for each team within the group study condition are presented in Table 3.2.

Table 3.2

Descriptive statistics of the participant teams within the group study condition

Team	<i>n</i>	Sex		Age		
		<i>Male</i>	<i>Female</i>	<i>Range</i>	<i>Mean</i>	<i>SD</i>
One	4	0	4	19–33	24.50	6.03
Two	2	0	2	18–23	20.50	3.54
Three	3	1	2	19–44	29.67	12.90
Four	3	0	3	20–21	20.33	0.58
Five	3	0	3	44–53	47.67	4.73
Six	2	0	2	20–22	21.00	1.41
Seven	3	2	1	19–21	20.00	1.00
Eight	3	1	2	18–19	18.67	0.58

Initial analysis of the data involved removing cases from the data set where the described inclusion criteria for participation had been violated. The data were screened to identify appropriate instances for removal due to statistical outliers and/or cases of undue influence. An in-depth description of the procedures and parameters that were used in this process is found in the results section (Section 3.4.2.). This resulted in a sample of $N = 54$ which consisted of 15 male (27.78%) and 39 female (72.22%) participants. Their ages ranged between 18 and 53 ($M = 24.98$; $SD = 1.85$) distributed approximately evenly between the three conditions (group, $n = 19$; solo, $n = 18$; and control, $n = 17$).

3.3.3. Materials.

Each participant received an information sheet (Appendices A₁ and A₂), a consent form (Appendix B) and a debrief form (Appendix C). Participants allocated to the group or solo study conditions also received standardised instructions (Appendix D). Each participant received and completed a demographic questionnaire (Appendix E).

The purpose of the information sheet was to explain the purpose and procedure of the study whilst stating the rights of participants in psychological research as stated by the British Psychological Society (BPS, 2014). This facilitated the procurement of fully-informed consent, which was recorded on the administered consent forms. Further to the requirements of the BPS, the debrief form was used to ensure participants were fully debriefed at the end of their research participation. The standardised instructions described the goals, rules, and controls of each of the activities (tennis, bowling, and golf) that are available on the Wii Sports computer game that participants in the group study condition and in the solo study condition would be interacting with. The demographic questionnaire consisted of seven items, which recorded participants' age, and sex, which was used to gather a demographic understanding of the participant sample, and physical activity habits, which was used to enforce the described inclusion and exclusion criteria.

3.3.3.1. Measures.

Participants in each of the study conditions were asked to complete three measures that are described within this section on a weekly basis across the duration of the experiment: the (Short Form) Social Support Questionnaire

([SSQ6] Sarason, Sarason, Shearin, & Pierce, 1987; Appendix F), the Self-Efficacy and Exercise Habits Survey ([SEEHS] Sallis, Pinski, Grossman, Patterson, & Nader, 1988; appendix G), and a self-report weekly physical activity questionnaire (appendix H).

The SSQ6 was used to measure the dependant variable social support and is comprised of two distinct factors that measure the quantity of received social support (Social Support Questionnaire number score – SSQN) and satisfaction with received social support (Social Support Questionnaire satisfaction score – SSQS). The SSQ6 consists of six items each with two-part responses (12 items). The first component of each pair required respondents to consider their social relationships in contrast to a given scenario and to indicate the number of people they could rely on for support by providing a list (of up to 12 individuals) of these individual's relationships to the respondent (e.g., brother, friend 1, employer). For example, item three: Whom can you really count on to help you feel more relaxed when you are under pressure or tense? The second component of each pair required respondents to indicate their level of satisfaction with the support that they perceive themselves to have. This was done on a six-point Likert scale (with end-points 'very satisfied and very dissatisfied').

The amount of received social support (SSQN) was then determined by averaging the responses for the six odd-numbered items (the scenario-based component of each item) which could result in scores of between zero and nine. Satisfaction with social support (SSQS) was determined similarly but, involved calculating the average between the six even-numbered items (the Likert scale component of each item) and could result in scores of between one and six. Inferential analysis included both the SSQN and SSQS factors in each set of analyses.

Sarason et al. (1987) report that the SSQ6 possesses strong internal reliability with Cronbach's α values ranging from .90 to .93 for both the SSQN and SSQS components of the measure. The SSQ6 was developed using factor analysis from the Social Support Questionnaire (Sarason et al., 1987), a 27-item measurement of social support. The Social Support Questionnaire possesses Cronbach's α values ranging from .96 to .97, suggesting that in transitioning from the original 27 item measure to the short-form SSQ6 there has been little loss in internal reliability. The authors also report that the Social Support Questionnaire possesses highly satisfactory test-retest reliability however, the actual value is not reported (Sarason et al., 1987).

The SEEHS was used to measure the dependant variable self-efficacy (for exercise) and consisted of 12 items and when administered to participants was renamed as the Exercise Confidence Survey, as advised by the measure's authors, to be clearer to respondents as to what the survey measures. Each item presented a scenario related to exercise behaviour, for example item three: exercise even though you are feeling depressed. Each item required respondents to indicate the likelihood that they would adopt the described behaviour using a five-point scale (with end-points 'I know I cannot' and 'I know I can', and a mid-point 'maybe I can'). There was an option for respondents to indicate that the scenario did not apply them.

The SEEHS can be split into two factors, which are named; sticking to it and making time for exercise, which represent different aspects of an individual's perceived capability to engage in physical activity. However, in the present study the SEEHS was scored by taking the average from the responses to all 12 items resulting in scores of between one and five. This is a common approach to scoring

the SEEHS and has been done so in a range of other studies either as an average (Goldschmidt et al., 2014; Janssen, Dugan, Karavolos, Lynch, & Powell, 2014) or by summing the items (Mansyur, Pavlik, Hyman, Taylor, & Goodrick, 2013).

Sallis et al. (1988) indicated that the SEEHS's factors possess internal consistency values of $\alpha = .83$ and $\alpha = .85$ for sticking to it and making time for exercise, respectively. The SEEHS has been found to possess concurrent criterion validity; this was established by correlating the measure's factor scores with participants' self-reported exercise habits, which were significantly correlated. Test-retest reliability has been documented for the SEEHS, with a value of $\alpha = .68$ (typically $\alpha = .7$ is considered to be acceptable). However, it is possible that the marginally below acceptable test-retest reliability finding may reflect changes in self-efficacy over time as this scale was developed using data from participants who were actively engaged in modifying their exercise behaviours.

Internal reliability scores for the SSQ6 factors and the SEEHS during the present study were calculated using Cronbach's α at each point of measurement during the intervention and are displayed in Table 3.3. Internal consistency scores were found to be at least acceptable ($.7 \leq \alpha < .8$), with the majority being between good ($.8 \leq \alpha < .9$), and excellent ($.9 \leq \alpha$).

Table 3.3

Internal reliability of the SSQ6's factors (SSQN and SSQS) and the SEEHS at each measurement point of the intervention

Time point	SSQ6		SEEHS
	SSQN	SSQS	
Baseline	.91	.88	.71
Week 1	.93	.90	.77
Week 2	.94	.89	.76
Week 3	.94	.88	.74
Week 4	.95	.92	.79
Week 5	.94	.92	.81
Week 6	.96	.92	.86
Week 7	.97	.93	.85
Week 8	.96	.92	.87

Note. Internal reliability measured using Cronbach's α ; SSQ6 = (short form) Social Support Questionnaire; SSQN = Social Support Questionnaire number score; SSQS = Social Support Questionnaire satisfaction score; SEEHS = Self-Efficacy and Exercise Habits Survey.

The self-report weekly physical activity questionnaire consisted of two sections for respondents to complete. The first section asked respondents to indicate the amount of aerobic activity, in minutes, that they had participated in within the previous seven days and to specify how much of this activity was of moderate-intensity and/or vigorous-intensity. Definitions of moderate and vigorous levels of aerobic activity were provided to assist respondents in completing this section correctly. The second section asked respondents to indicate the frequency of their aerobic activity within the previous seven days using a five-point scale with end-points 'once' and 'more than once a day'. Both sections of this document were used to measure the dependant variable physical activity. If a respondent had not

exercised within the previous seven days then they were advised to leave this section blank.

3.3.3.2. Apparatus.

Participants within the group and solo study conditions interacted with the computer game *Wii Sports* (developed by Nintendo in 2006), which was displayed to participants on a large flat-screen television (see Figure 3.2., for laboratory layout and depiction of the tennis activity available in *Wii Sports*). *Wii Sports* allows players to choose from a range of real-world inspired sporting activities to play and simulates a lifelike manner in how the activities are interacted with, for example a player swinging the Wiimote (the handheld remote controller) in the fashion that a tennis player would swing a racquet to hit a tennis ball.



Figure 3.2. Setup of laboratory and apparatus that was used (Study 1).

A Nintendo Wii computer games console was used to run the *Wii Sports* computer game. This device can interpret movement-based input through its motion-based controllers (using an accelerometer) and infra-red motion sensor detection bar. This technology is used to allow players to interact with the console and computer

game using physical movement designed to simulate the movements involved in real-world sports.

3.3.4. Procedure.

The process that was used to allocate participants to the study's conditions is described first. This is followed by distinct sub-sections that describe the experimental procedure for each study condition. The study was granted ethics clearance by Teesside University's research ethics committee.

Upon recruitment to the study, through an online research participation recruitment system, participants were allocated to either the group, solo, or control study condition using random allocation, in the case of the solo and control study conditions, and non-random allocation for the group study condition. Non-random allocation into the group study condition was decided upon for feasibility reasons. The group study condition required between two-to-four participants to not only participate simultaneously during the initial laboratory session but also to be able to attend the laboratory, on a consistent day and time, in each subsequent week for simultaneous participation until the end of the eighth week of the intervention. If participants were randomly allocated to this condition then it would be improbable that between them they could conveniently participate simultaneously each week over an eight-week period on consistent days and/or times.

3.3.4.1. Group and solo study conditions.

When participants arrived at the laboratory they were each given an information sheet and a consent form next, the demographic questionnaire was administered. Participants then were given a copy of the SSQ6 and the SEEHS to complete in order to attain a baseline measurement.

Participants then were given the standardised instruction to familiarise themselves with the computer game Wii Sports and its controls. The instructions and the experimenter informed participants that only three of the five available Wii Sports activities were to be played during the experiment. These were tennis, bowling and golf. This was because these three activities can be played with between one and four players whereas only one or two players can play the two excluded games (baseball and boxing). Therefore, all members of the group study condition could play simultaneously and participants within the solo study condition would play the same games as the group study condition thereby, minimising potential confounding variables.

Participants were then given 30 minutes to play the Wii Sports computer game. They were encouraged to choose amongst themselves (group study condition) or by themselves (solo study condition) which of the three authorised games they wished to play and for how long within the 30 minute window (i.e., players could change between tennis, bowling, and golf volitionally).

Following computer game play, participants were asked to complete another copy of the SSQ6 and the SEEHS and in addition, the self-report weekly physical activity questionnaire. Once these had been completed the experimental session was finished. Participants were asked to return to the laboratory weekly (on the same day and at the same time) in order to participate a further seven times in similar sessions. Experimental sessions after week one involved just the 30 minutes of computer game play and the described post-game play measurements.

3.3.4.2. Control study condition.

When participants arrived at the laboratory they were given an information sheet and consent form to read and complete, which was followed by a demographic questionnaire. Participants were then asked to complete the SSQ6, SEEHS, and the self-report weekly physical activity questionnaire. Participants were asked to return to the laboratory on a weekly basis in order to complete the same measurements a further seven times. Unlike the group and solo study conditions, participants within the control study condition were not required to complete measurements twice during the first week of the intervention (baseline and week one). This is because the control study condition did not include experimental stimuli (the Wii Sports computer game) and as such before (baseline) and after (week one) stimuli exposure measurements could not be made.

3.3.5. Pilot study and feedback.

The initial design and method of this experiment differed from that reported within this method section, a two-week pilot study involving four participants was conducted to test the study's procedure and materials for appropriateness. After consideration of feedback in the form of an informal focus discussion group between the pilot participants and the researcher, methodological changes were made which conform to that which is reported within the main body of the method section.

Specifically, computer game exposure time was changed from 45 minutes to 30 minutes following feedback indicating that the computer game activities could become boring to participants, especially possible for those allocated to the solo study condition. Justification for this was given in that many individuals that were

expected to participate within the study would be university students who are restricted in time commitments, typically to an hourly timetable. A game play period of 30 minutes along with questionnaire completion allowed each laboratory session to be completed within an hour thereby making the study appear more attractive for participation due to convenience.

Pilot participants expressed concern over the potential of identification through personal details recorded in the SSQ6, this was because the unmodified iteration of the SSQ6 indicated for participants to record the initials of people who could be relied upon in each instance as well as the relation to the participant. It was felt that this much information could be potentially used to identify participants which would violate ethical codes of conduct for confidentiality. As such, an agreeable solution was to remove the need to include initials and state only relations to an individual such as 'friend, colleague, parent' which were thought to be sufficiently vague as to avoid identification.

Suggestions were also made to re-arrange furniture and the position of the television within the laboratory to make better use of the available space.

Feedback indicated that during simultaneous game play such as when playing the tennis game there was insufficient available space affecting enjoyment of the game. Also importantly, there were safety concerns as there was insufficient space around each participant to swing the game remotes without risk of injury to others. This feedback resulted in the setup pictured in Figure 3.2., which during the 2nd week of the pilot study was thought to be more space efficient and enjoyable during computer game play.

3.3.6. Data analysis.

Hypotheses H_{1a-d} were tested using 3×2 mixed analysis of variance (ANOVA),

hypotheses H_{2a-d} were tested using analysis of covariance (ANCOVA).

Justification for the use of these inferential techniques is provided in Section 3.4.

Additionally, in order to provide further depth to the analysis, magnitude-based inferences (MBIs) were conducted using the planned comparisons from both the 3×2 mixed ANOVA and ANCOVA testing (see Section 3.4.3.1. for a description of MBI).

Mediation analysis was used to measure the proposed mediating effect of self-efficacy, derived from social support on increasing physical activity (H_3). Modern techniques of mediation analysis, which involve the use of bootstrapping techniques were adopted due to the robust theoretical support (Field, 2017; Hayes, 2018; Mackinnon, 2008; Zhao, Lynch & Chen, 2010) that this technique possesses.

To summarise, Table 3.4 outlines the present study's hypotheses alongside the respective analytical methods that were used to test them.

Table 3.4

Study 1 hypotheses and analytical methods used to test them

H _#	Statement of outcome	Analysis
H _{1a}	Group activity increases social support over time more than solo activity does.	Mixed 3×2 ANOVA
H _{1b}	Group activity increases self-efficacy over time more than solo activity does.	
H _{1c}	Group activity increases moderate-and/or vigorous-intensity physical activity over time more than solo activity does.	
H _{1d}	Group activity increases the frequency of physical activity over time more than solo activity does.	
H _{2a}	Computer game play produces greater levels of social support when compared to no computer game play, but only when the computer game play is sociable.	ANCOVA
H _{2b}	Computer game play produces greater levels of self-efficacy when compared to no computer game play, but only when the computer game play is sociable.	
H _{2c}	Computer game play produces greater levels of moderate-and/or vigorous-intensity physical activity when compared to no computer game play, but only when the computer game play is sociable.	
H _{2d}	Computer game play produces a greater frequency of physical activity when compared to no computer game play, but only when the computer game play is sociable.	
H ₃	Self-efficacy mediates the effect of social support on physical activity.	Mediation analysis

3.4. Results - Study 1

For ease of comprehension this results section has been structured into a series of subsections, each pertaining to different parts of the analyses. Due to the nature of the experiment each sub-section is further structured to describe each of the outcome variables independently (i.e., social support, self-efficacy, and physical activity). Inferential analyses were conducted twice in most cases to test both factors of the SSQ6. Where this has been the case analysis outcomes will be presented with tests including the SSQN factor first, followed by the SSQS factor tests. Physical activity was measured as four distinct measurements: moderate-intensity aerobic activity, vigorous-intensity aerobic activity, total aerobic physical activity (sum of moderate-intensity and vigorous-intensity physical activity) and frequency of aerobic physical activity.

The initial descriptive analyses (Section 3.4.1.) were produced after the removal of participants who violated the study's inclusion criteria as well as appropriately removed statistical outliers and cases of undue influence. The parameters that were used in this process as well as specific information regarding data that was removed from the data set are described in detail within the data screening subsection (Section 3.4.2.).

To test the hypotheses H_{1a-d} inferential analysis involved 3×2 mixed ANOVA and to test hypotheses H_{2a-d} ANCOVA was used. Mixed ANOVA and ANCOVA were conducted for each outcome variable. Study condition was the independent variable for the mixed ANOVA (between-groups) and ANCOVA, which consisted of three levels: group, solo, and control. Time point was an independent variable (within-groups) in mixed ANOVA, which consisted of two levels: initial

measurement and week eight measurement. Dependent variables were initial and week eight measurements, for mixed ANOVA, and week eight measurements, for ANCOVA, of social support (SSQN and SSQS), self-efficacy (SEEHS), and physical activity (moderate, vigorous, total, and frequency). The covariates tested in ANCOVA were the initial measurement of social support, self-efficacy, and physical activity (see Section 3.4.3.8. for specific information).

Hypotheses H_{1a-d} state that an increase in social support, self-efficacy, and/or physical activity occurs, over the duration of the intervention, with sociable computer game play more so than with solitary computer game play. As such, 3×2 mixed ANOVA was selected as the inferential test to be conducted in order to test for any difference in changes as a function of treatment through the main effect and also, importantly, for a potential interaction effect between time and treatment. Hypotheses H_{2a-d} , state that levels of social support, self-efficacy, and/or physical activity are greater following sociable computer game play, rather than solitary computer game play, when compared with no computer game play. Therefore, ANCOVA was selected as the inferential test to be conducted in order to test the effect of the sociable computer game play treatment against that of solo computer game play and no computer game play. An added benefit of performing ANCOVA is that any potential bias from initial dependent variable measurement can be accounted for. Mixed ANOVA and ANCOVA are supplemented with MBIs to provide further rich information regarding the outcome of the intervention (see Section 3.4.2.1. for information regarding MBI testing).

To test hypothesis H_3 , mediation analyses was conducted using social support (SSQN/SSQS) as the predictor(s), self-efficacy as the mediator, and physical activity (moderate, vigorous, total, and frequency) as the outcome(s).

3.4.1. Descriptive Analysis.

Initial descriptive analysis involved producing averages and standard deviations for each outcome variable at each measurement point of the eight-week intervention period. This information serves to summarise the collected sample data to provide an initial description of measured observations that were recorded during the intervention.

3.4.1.1. Social Support.

Tables 3.5 and 3.6 display the mean scores and standard deviations of the SSQN and SSQS factors of the SSQ6 for each study condition at each measurement point of the intervention, Figures 3.3. and 3.4. represent this information graphically.

Table 3.5

Mean scores and standard deviations of the SSQN factor of the SSQ6 by study condition at each measurement point of the intervention

Time point	Group		Solo		Control	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Baseline	3.34	1.87	3.57	1.53	-	-
Week 1	3.64	2.06	3.56	1.58	4.16	1.91
Week 2	3.38	1.65	3.57	1.75	4.17	2.02
Week 3	4.17	1.89	3.55	1.74	4.24	2.07
Week 4	3.81	1.87	3.63	1.67	4.38	1.98
Week 5	3.80	1.18	3.63	1.94	4.38	2.11
Week 6	4.29	2.00	3.82	1.92	4.28	2.25
Week 7	4.17	1.99	3.69	2.15	4.67	2.38
Week 8	4.61	1.93	3.81	2.13	4.39	2.34

Note. Data collection for the control study condition began at week one therefore no distinct baseline measurement for this condition was taken.

Initial mean SSQN measurement found that the group and solo study conditions had similar scores whereas, the control study condition was initially recorded to have a larger mean SSQN score. The changes in mean SSQN scores when comparing initial and week eight measurements represent an increase in mean SSQN score across all three conditions. These changes had an above moderate effect size of $d = 0.69$ for the group study condition and below small effect sizes of $d = 0.13$ and $d = 0.11$ for the solo and control study conditions, respectively.

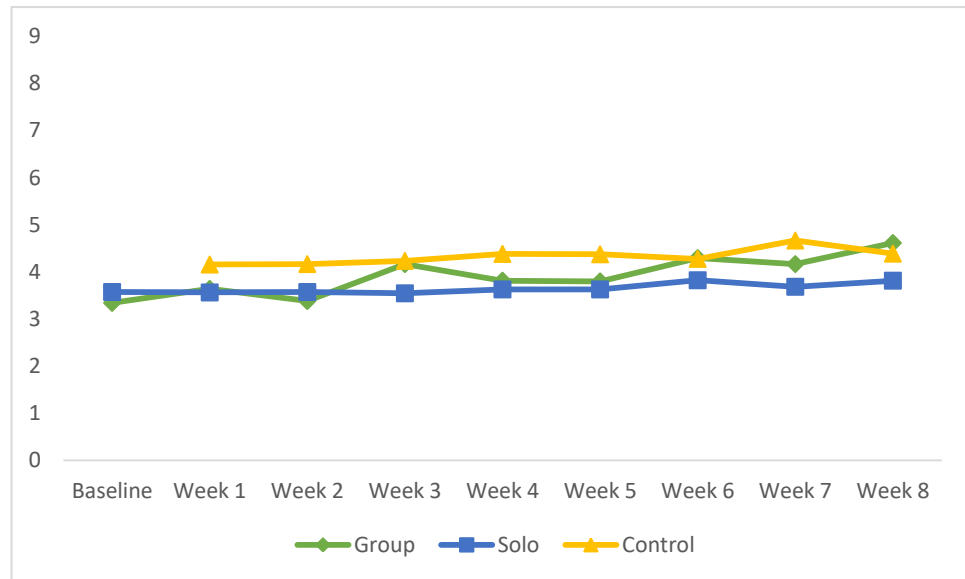


Figure 3.3. Mean scores of the SSQN factor as a function of study condition over time.

Mean SSQN scores did appear to fluctuate during the course of the intervention, most notably in the group study condition where a series of peaks and troughs occurred. The solo and control study conditions appeared to be relatively stable in mean SSQN across the intervention.

Table 3.6

Mean scores and standard deviations of the SSQS factor of the SSQ6 by study condition at each measurement point of the intervention

Time point	Group		Solo		Control	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Baseline	5.04	1.06	5.16	0.58	-	-
Week 1	5.11	1.03	5.22	0.51	5.34	0.67
Week 2	5.03	0.96	5.10	0.66	5.24	0.76
Week 3	5.10	1.03	5.09	0.71	5.25	0.73
Week 4	5.19	0.99	5.12	0.68	5.30	0.68
Week 5	5.20	0.78	5.16	0.72	5.26	0.87
Week 6	5.28	0.84	5.20	0.70	5.27	0.76
Week 7	5.23	1.02	5.13	0.79	5.42	0.58
Week 8	5.51	0.57	5.05	0.94	5.35	0.75

Note. Data collection for the control study condition began at week one therefore no distinct baseline measurement for this condition was taken.

Initial mean SSQS measurement found that the study conditions had similar scores with the control study condition recorded to have the most and the group study condition recorded to the least. The changes in mean SSQS scores when comparing initial and week eight measurements represent an increase in mean SSQS score in the group and control study conditions, and a decrease in the solo study condition. These changes had an above moderate effect size of $d = 0.56$ for the group study condition and below small effect sizes of $d = -0.14$ and $d = 0.01$ for the solo and control study conditions, respectively.

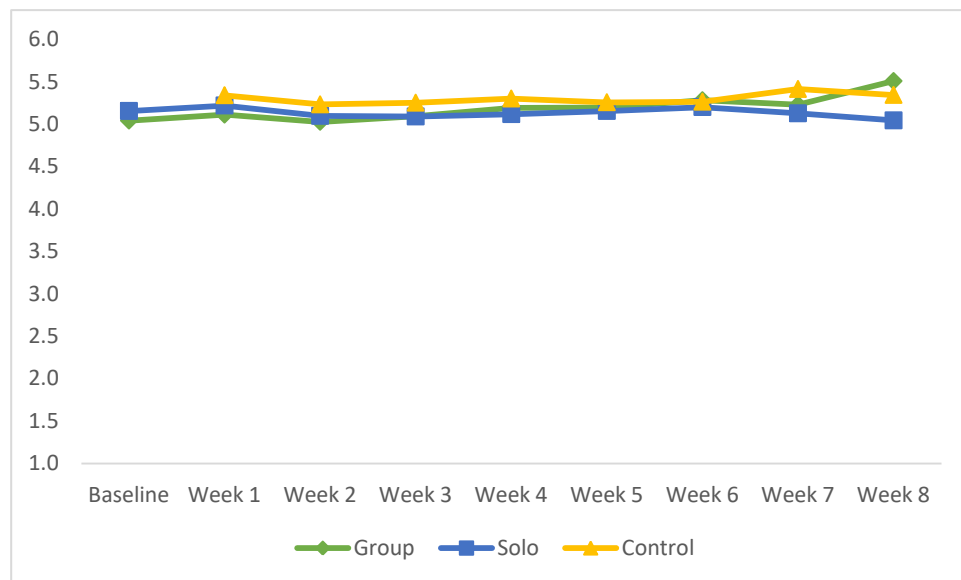


Figure 3.4. Mean scores of the SSQS factor as a function of study condition over time.

Despite having relatively similar initial mean SSQS scores the three groups noticeably differed in mean SSQS score at week eight of the intervention. During the course of the intervention, minor fluctuations in mean SSQS score occurred in each of the study conditions.

3.4.1.2. Self-efficacy.

Table 3.7 displays the mean scores and standard deviations of the SEEHS for each study condition at each measurement point of the intervention. The results are presented graphically in Figure 3.5.

Table 3.7

Mean scores and standard deviations of the SEEHS by study condition at each measurement point of the intervention

Time point	Group		Solo		Control	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Baseline	3.07	0.47	3.08	0.51	-	-
Week 1	3.21	0.57	3.21	0.56	3.13	0.64
Week 2	3.25	0.60	3.32	0.54	3.11	0.65
Week 3	3.41	0.58	3.51	0.51	3.19	0.58
Week 4	3.37	0.67	3.53	0.61	3.25	0.60
Week 5	3.53	0.64	3.57	0.58	3.20	0.66
Week 6	3.24	0.58	3.58	0.71	3.03	0.76
Week 7	3.35	0.64	3.58	0.61	3.02	0.78
Week 8	3.60	0.75	3.61	0.71	3.21	0.56

Note. Data collection for the control study condition began at week one; therefore no distinct baseline measurement for this condition was taken.

Initial measurement found that the group and solo study conditions were very similar in mean SEEHS score, which were marginally lower than the control study condition. The changes in mean SEEHS scores when comparing initial and week eight measurements represent an increase in mean SEEHS score in each of the study conditions. These changes had an above large effect size of $d = 0.89$ and $d = 0.88$ for the group and solo study conditions, respectively, and a below small effect size of $d = 0.14$ for the control study condition.

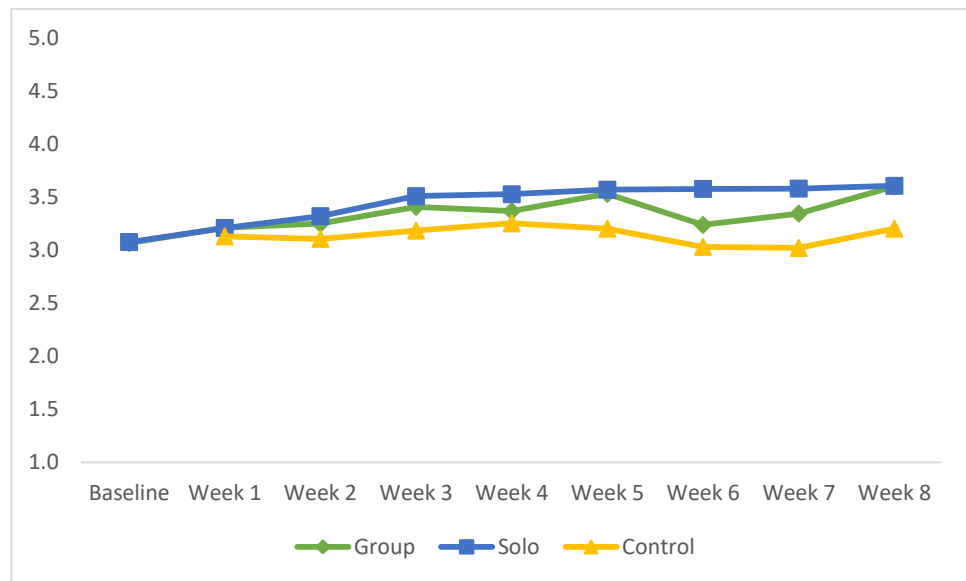


Figure 3.5. Mean SEEHS score as a function of study condition over time.

Figure 3.5. shows that the changes in self-efficacy described in Table 3.7 occurred at inconsistent time points and to varying degrees between the conditions. The group study condition, for example, recorded SEEHS scores increasing and decreasing with little pattern during the intervention. Conversely, the solo study condition recorded consistently increasing SEEHS scores in small increments at each measurement point. Despite this, both the group and solo study conditions had recorded almost identical amounts of self-efficacy by the culmination of the intervention.

3.4.1.3. Physical activity.

Four different functions of physical activity were recorded, these include moderate-intensity and vigorous-intensity physical activity, total physical activity (sum of moderate- and vigorous-intensity physical activity), and the frequency of physical activity. Each of these physical activity measurements are described in tabular and graphical format in the following four subsections.

3.4.1.3.1. Moderate-intensity physical activity.

Table 3.8

Mean scores and standard deviations of moderate-intensity physical activity by study condition at each measurement point of the intervention

Time point	Group		Solo		Control	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Week 1	50.53	50.63	43.89	35.17	48.82	51.71
Week 2	44.71	43.03	46.11	34.41	48.24	58.97
Week 3	63.24	59.45	51.28	43.82	54.71	71.34
Week 4	66.94	64.51	56.39	49.07	93.53	150.62
Week 5	53.00	55.16	56.39	93.57	113.75	143.35
Week 6	43.53	43.00	44.06	42.05	95.33	155.65
Week 7	68.53	139.93	38.89	33.10	135.36	210.92
Week 8	57.81	61.07	41.39	42.18	65.00	65.27

Initial measurement identified the group study condition to have had the highest levels of moderate-intensity physical activity at week one, and the solo study condition to have had the lowest. The changes in levels of moderate-intensity physical activity when comparing week one and week eight measurements represent an increase in the group and control study conditions and a decrease in the solo study condition. These changes had a small effect size of $d = 0.29$ for the control study condition and below small effect sizes of $d = 0.13$ and $d = -0.07$ for the group and solo study conditions, respectively.

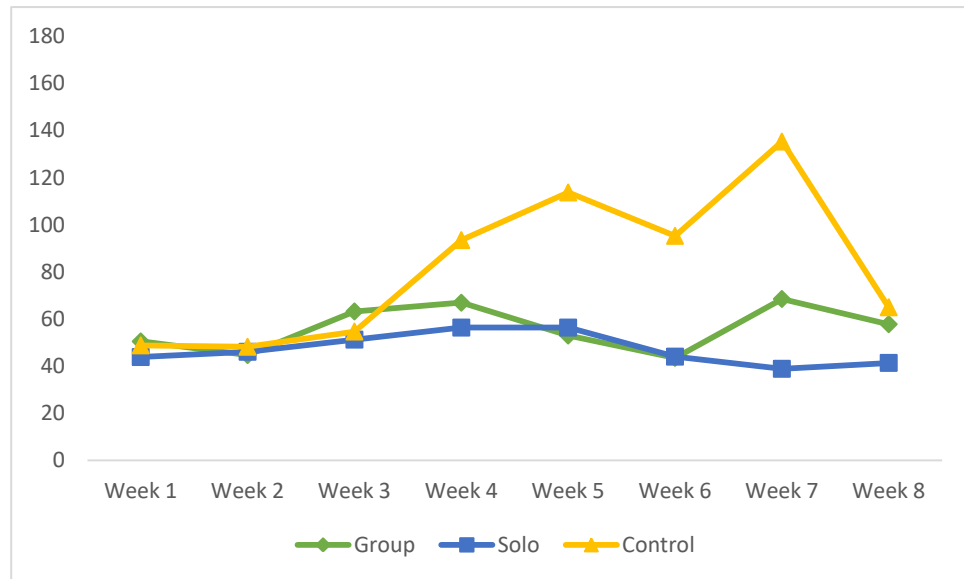


Figure 3.6. Mean moderate-intensity physical activity (minutes) as a function of study condition over time.

The amount of reported moderate-intensity physical activity at week eight appeared to increase in both the group and control study conditions from their respective week one measurements (Figure 3.6.). However, during the intervention, changes in moderate-intensity physical activity appeared to occur frequently and with little pattern as the various peaks and troughs indicate.

3.4.1.3.2. Vigorous-intensity physical activity.

Table 3.9

Mean scores and standard deviations of vigorous-intensity physical activity by study condition at each measurement point of the intervention

Time point	Group		Solo		Control	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Week 1	18.95	33.56	13.33	18.55	33.53	64.51
Week 2	20.00	50.50	12.22	26.75	12.35	21.00
Week 3	22.35	59.35	23.89	34.83	10.59	21.35
Week 4	27.78	70.69	12.22	17.76	10.59	18.86
Week 5	36.33	45.77	5.00	9.07	20.31	40.64
Week 6	26.47	51.83	8.44	16.43	21.00	33.97
Week 7	13.24	27.55	13.00	16.39	23.57	41.06
Week 8	31.25	48.84	11.39	18.21	13.67	21.59

Initial measurement identified the control study condition to have had the highest levels of vigorous-intensity physical activity at week one, and the solo study condition to have had the lowest. The changes in levels of vigorous-intensity physical activity when comparing week one and week eight measurements represent an increase in the group study condition and a decrease in the solo and control study conditions. These changes had an above small effect size of $d = 0.31$ and $d = -0.42$ for the group and control study conditions, respectively, and a below small effect size of $d = -0.11$ for the solo study condition.

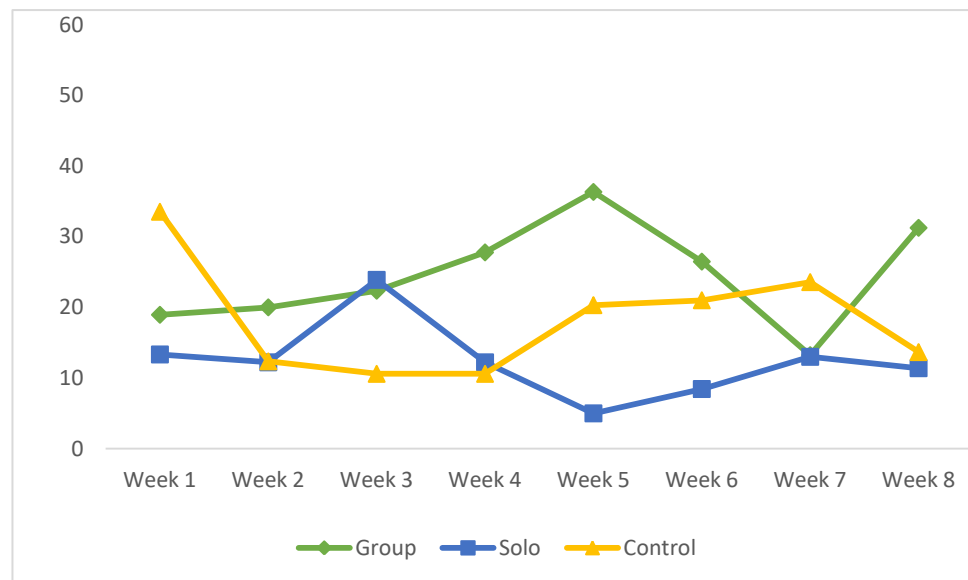


Figure 3.7. Mean vigorous-intensity physical activity (minutes) as a function of study condition over time.

Similarly to the recorded levels of moderate-intensity physical activity that was displayed in Figure 3.7., the reported levels of vigorous-intensity physical activity (Figure 3.8.) also fluctuate with no discernible pattern and more extremely so. The group study condition did appear to increase consistently in reported vigorous-intensity physical activity from the start of the intervention up until the fifth week, which then dropped in weeks six and seven and then increased again to above initial levels at the eighth week.

3.4.1.3.3. Total physical activity.

Table 3.10

Mean reported total physical activity in minutes by study condition at each measurement point of the intervention

Time point	Group		Solo		Control	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Week 1	69.47	70.83	57.22	41.74	82.35	85.19
Week 2	64.71	85.59	58.33	47.65	60.59	70.73
Week 3	85.59	108.70	75.17	58.16	65.29	82.40
Week 4	94.72	109.89	68.61	60.12	104.12	155.20
Week 5	89.33	79.80	61.39	94.02	134.06	156.50
Week 6	70.00	75.42	52.50	51.20	116.33	156.72
Week 7	81.76	138.90	51.89	39.79	158.93	213.06
Week 8	89.06	82.22	52.78	45.61	78.67	70.70

Initial measurement identified the control study condition to have had the highest levels of total physical activity at week one, and the solo study condition to have had the lowest. The changes in levels of total physical activity when comparing week one and week eight measurements represent an increase in the group study condition and a decrease in the solo and control study conditions. These changes had an above small effect size of $d = 0.26$ for the group study condition and below small effect sizes of $d = -0.10$ and $d = -0.05$ for the solo and control study conditions, respectively.

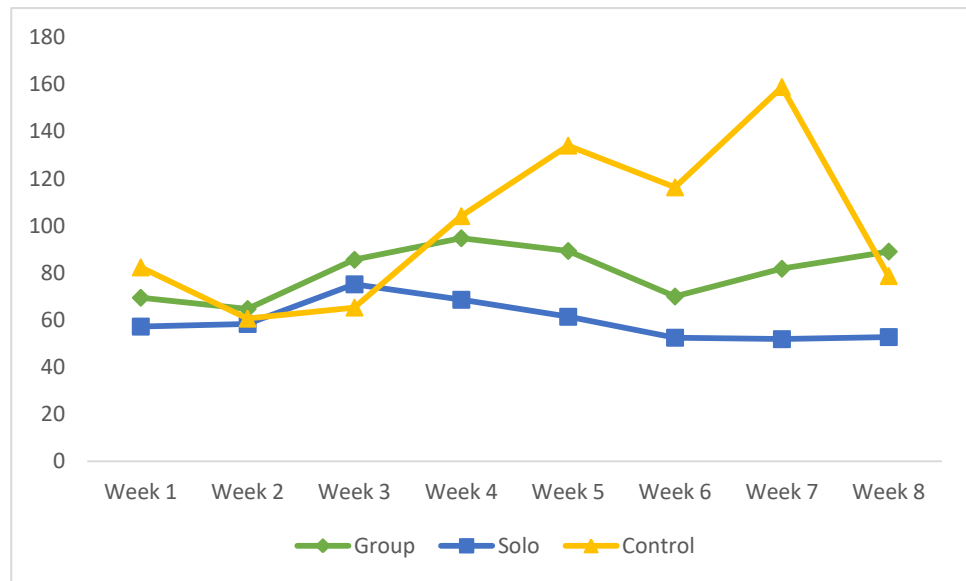


Figure 3.8. Mean total physical activity (minutes) as a function of study condition over time.

Initial assessment of Figure 3.8 suggests that the control study condition reported inconsistent quantities of total physical activity each week, as can be seen by the various peaks and troughs. The group study condition did however consistently increase in reported total physical activity from week two to week five of the intervention which was followed by a drop in physical activity during week six before returning to previous levels of physical activity for the remainder of the intervention. Additionally, the solo study condition appeared to report consistent reductions in total physical activity between week three and week six of the intervention, which remained at a relatively constant quantity of physical activity for the remainder of the intervention.

3.4.1.3.4. Frequency of physical activity.

Table 3.11

Mean scores and standard deviations of reported frequency of physical activity by study condition at each measurement point of the intervention

Time point	Group		Solo		Control	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Week 1	1.89	1.52	2.00	1.37	1.82	1.51
Week 2	2.88	4.59	1.94	1.39	1.35	1.17
Week 3	2.06	1.34	1.94	1.39	1.35	1.62
Week 4	1.94	1.35	1.78	1.44	1.53	1.62
Week 5	2.13	1.51	1.67	1.46	1.63	1.26
Week 6	1.65	1.37	1.94	1.39	1.53	1.25
Week 7	1.76	1.25	1.83	1.42	1.79	1.31
Week 8	2.38	1.67	1.83	1.42	1.60	1.18

Initial measurement identified the solo study condition to engage in physical activity most frequently and the control study condition to do so the least frequently. The changes in the frequency of engagement in physical activity when comparing week one and week eight measurements represent an increase in the group study condition and a decrease in the solo and control study conditions. These changes had an above small effect size of $d = 0.32$ for the group study condition and below small effect sizes of $d = -0.13$ and $d = -0.17$ for the solo and control study conditions, respectively.

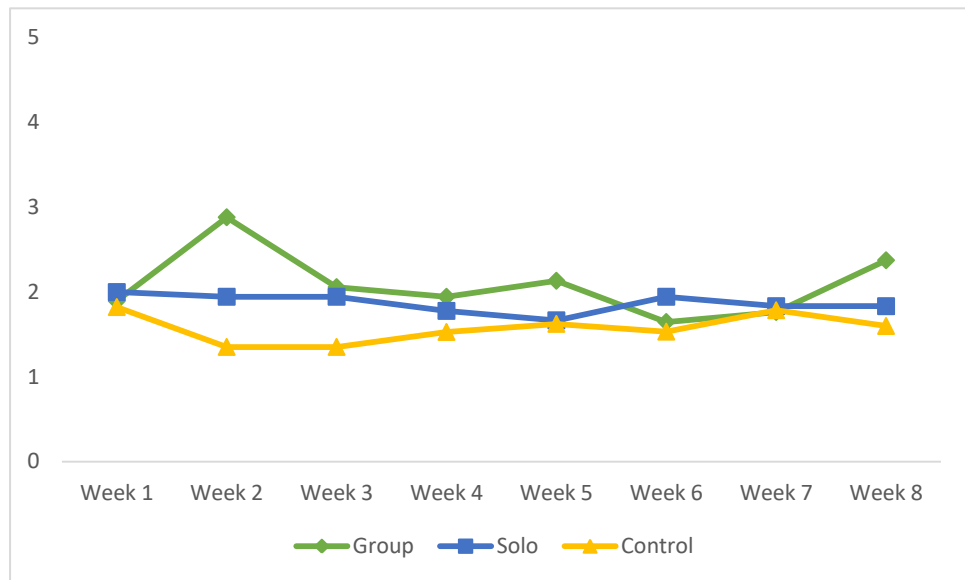


Figure 3.9. Mean frequency of physical activity ranging from 0 (never) to 5 (more than once a day) as a function of study condition over time.

The solo and control study conditions reported similar frequencies of physical activity at the beginning and end-points of the intervention but fluctuated during the course of the intervention with the solo study condition typically reporting more. The group study condition was inconsistent in the reported frequency of physical activity as well, with large variations occurring between measurements points during the intervention.

3.4.2. Data Screening.

Inferential analysis involved 3×2 mixed ANOVA and ANCOVA, which were supplemented with MBIs and mediation analysis. Details of and their respective outcomes are presented in this order (Sections 3.4.3.2. for mixed ANOVA, 3.4.3.8. for ANCOVA, and 3.4.3.14. for mediation analysis).

As parametric statistical tests are being incorporated into the analysis, the data must satisfy certain parametric assumptions; therefore, this sub-section is concerned with determining whether the data do so or not and, consequently, whether the described analytical tests are appropriate to use.

When performing mixed ANOVA and ANCOVA the data must satisfy the following parametric assumptions: the dependent variable data need to be recorded at interval or ratio level, sample means need to be normally distributed, independence of scores are required, and homogeneity (and/or sphericity where appropriate) of variances are required. Additionally however, ANCOVA requires that the covariate is independent to the treatment effect and that homogeneity of regression slopes is present.

Initial data screening involved the identification and removal of cases that violated the inclusion criteria of the study which required that participants typically engage in less than 150 minutes of moderate-intensity aerobic activity or 75 minutes of vigorous-intensity aerobic activity each week. This resulted in the removal of eight cases from the data set, each of whom upon reporting the quantities of moderate- and/or vigorous-intensity aerobic activity were found to have violated the limits of the inclusion criteria on a frequent basis (i.e. at 75% or more of measurement points). Furthermore, an additional two cases were removed from the data-set as it was identified that these two cases participated in just two out of the eight laboratory sessions that the intervention consisted of.

The next step of the data screening process involved the identification and, where appropriate to do so, removal of outliers. These checks involved visual inspection of histograms and box plots; furthermore, ANCOVAs were conducted as regressions on each outcome variable (SSQN, SSQS, SEEHS, moderate-intensity, vigorous-intensity, total, and frequency of physical activity) in order to examine standardised residuals and Cook's distance values.

The parameters that were used to identify outliers are those recommended by Field (2017) who suggests using sample characteristic probabilities, in conjunction

with standardised residuals, where in a normal distribution it is expected that 95% of cases will have standardised residuals within ± 1.96 and that 99% of cases will present within ± 2.58 . Field (2017) argues that any standardised residual values that fall outside of these probabilities as well as any that are greater than ± 3.29 are sufficient for investigation.

The parameters used to identify cases of undue influence with Cook's distance were calculated using the equation $4/n$ (Bollen & Jackman, 1990), as opposed to the frequently used value of one as a cut-off. The reason for this decision is that the equation is sensitive to sample size, with the cut-off value changing depending upon how many participants there are and is therefore adaptable and less conservative than one as a cut-off. As such, a cut-off value was calculated for each study condition, due to differences in the number of cases between conditions, which equalled 0.25 for the group study condition, 0.22 for the solo study condition, and 0.27 for the control study condition.

As a result of the data screening, one case (case 52) was identified for removal from the data set, due to outlying SEEHS data of which also exceeded the associated Cook's distance cut-off value (standardised residual = -2.49; Cook's distance = 0.39 > 0.22 cut-off). A potential explanation for these results was unexpected life events as the participant had recorded consistent levels of self-efficacy for the first two weeks of the intervention but then reported large reductions in self-efficacy beginning at week three through to the end of the intervention.

Following the described removal of cases the data were re-analysed and found to be within acceptable parameters of distribution by visual inspection of histograms (satisfying the parametric assumption of equal distribution of scores).

The covariates under investigation were found to be independent of the experimental effect. This was determined by conducting a series of ANOVAs with each covariate entered, independently, as dependent variables and participant condition as the independent variable. Participant condition was found not to have a statistically significant relationship with any covariate as can be seen in Table 3.12; thereby satisfying the parametric assumption of independence of the covariate for ANCOVA testing.

Table 3.12

Test of the independence of covariate parametric assumption in ANCOVA

Covariate	ANOVA outcome
SSQN	$F(2, 51) = 0.99, p = .379$
SSQS	$F(2, 51) = 0.63, p = .538$
SEEHS	$F(2, 50) = 0.07, p = .934$
Moderate-intensity physical activity	$F(2, 51) = 0.10, p = .904$
Vigorous-intensity physical activity	$F(2, 51) = 1.04, p = .361$
Total physical activity	$F(2, 51) = 0.60, p = .554$
Frequency of physical activity	$F(2, 51) = 0.06, p = .938$

Note. SSQN = Social Support Questionnaire number score; SSQS = Social Support Questionnaire satisfaction score; SEEHS = Self-Efficacy and Exercise Habits Survey.

The remaining parametric assumptions to be tested are homogeneity of variance (or sphericity where appropriate) and homogeneity of regression slopes. The outcomes of the diagnostics testing these assumptions are presented below.

First, the homogeneity of variance assumption was tested using Levene's test and variance ratios (also known as Hartley's F_{\max} test) as per Field's (2016, 2017) recommendations who warns against the sole reliance upon Levene's test to

determine if homogeneity can be assumed or not. The outcome of the Levene's tests as well as each outcome variable's associated variance ratio are presented in Tables 3.13 and 3.14 and were conducted as part of the 3×2 mixed ANOVA (Table 3.13) and ANCOVA (Table 3.14) tests that were described at the beginning of this section, respectively.

Table 3.13

Homogeneity of variance test for 3×2 mixed ANOVA and associated variance ratios

Outcome variable	Initial measurement		Week eight measurement	
	Levene's test	Variance ratio	Levene's test	Variance ratio
SSQN	$F(2, 46) = 0.66, p = .520$	1.57	$F(2, 46) = 0.84, p = .439$	1.46
SSQS	$F(2, 46) = 0.54, p = .584$	3.35	$F(2, 46) = 0.92, p = .408$	2.77
SEEHS	$F(2, 45) = 0.22, p = .802$	1.85	$F(2, 45) = 1.10, p = .342$	1.76
Mod PA	$F(2, 46) = 1.12, p = .334$	2.16	$F(2, 46) = 2.57, p = .087$	2.40
Vig PA	$F(2, 46) = 4.49, p = .017$	12.09	$F(2, 46) = 9.37, p = .000$	7.19
Total PA	$F(2, 46) = 4.53, p = .016$	4.17	$F(2, 46) = 4.20, p = .021$	3.25
PA frequency	$F(2, 46) = 0.52, p = .599$	1.23	$F(2, 46) = 1.07, p = .350$	1.99

Note. SSQN = Social Support Questionnaire number score; SSQS = Social Support Questionnaire satisfaction score SEEHS = Self-Efficacy and Exercise Habits Survey; Mod = moderate-intensity; Vig = vigorous-intensity; PA = physical activity.

The Levene's test statistic was violated when conducting 3×2 mixed ANOVA on the vigorous-intensity physical activity and total physical activity outcome variables for the initial measurement and the week eight measurement (see Table 3.13).

Violations of Levene's test statistic occurred under ANCOVA as well with the SSQS, vigorous-intensity physical activity and the frequency of physical activity outcome variables (see Table 3.14).

Table 3.14

Homogeneity of variance test for ANCOVA and associated variance ratios

Outcome variable	Levene's test	Variance ratio
SSQN	$F(2, 46) = 0.97, p = .385$	1.46
SSQS	$F(2, 46) = 3.49, p = .039$	2.77
SEEHS	$F(2, 45) = 1.04, p = .361$	1.76
Moderate-intensity PA	$F(2, 46) = 0.50, p = .611$	2.40
Vigorous-intensity PA	$F(2, 46) = 8.57, p = .001$	7.19
Total PA	$F(2, 46) = 2.85, p = .068$	3.25
PA frequency	$F(2, 46) = 3.64, p = .034$	1.99

Note. SSQN = Social Support Questionnaire number score; SSQS = Social Support Questionnaire satisfaction score; SEEHS = Self-Efficacy and Exercise Habits Survey; PA = physical activity.

Each variance ratio was produced by calculating the variance of an outcome variable for each study condition and then dividing the largest variance by the smallest variance to create a ratio. The calculated variance ratios were then compared to a sampling distribution of F_{\max} table to determine if they exceed their respective cut-off values (Appendix I, Table I1). Because degrees of freedom are used to identify the cut-off values in F_{\max} tables, which are typically given in increments larger than one, linear interpolation was used to identify precise cut-off values for the actual degrees of freedom values that were used in the present study (Appendix I, Figures I1. and I2.).

Therefore, through linear interpolation (Appendix I, Table I2) the variance ratio critical values were calculated to be 3.75 ($df = 14$), 3.54 ($df = 15$), 3.42 ($df = 16$), 3.30 ($df = 17$), and 3.19 ($df = 18$). As such, the variance ratios in Tables 3.13 and 3.14 that violate their respective cut-off values are for the outcome variables vigorous-physical activity at initial measurement (value = 12.09; cut-off = 3.42) and

week eight (value = 7.19; cut-off = 3.75) for 3×2 mixed ANOVA and ANCOVA (value = 7.19; cut-off = 3.75) as well as total physical activity at initial measurement (value = 4.17; cut-off = 3.42) and are therefore heterogeneous. As such to account for the increase in the probability of making a Type I error that variance heterogeneity can lead to, Keppel (1991) suggests adopting a more stringent significance level (from $\alpha = .05$ to $\alpha = .025$). Therefore, the 3×2 mixed ANOVA tests that involved the vigorous- and total physical activity outcome variables were tested at a .025 significance level as well as for ANCOVA tests involving the vigorous-physical activity outcome variable.

Second, the assumption of homogeneity of regression slopes was tested by conducting an ANCOVA for each outcome variable while including an interaction effect between the independent variable (study condition) and covariate (initial outcome measurement), the (non)significance of which determines if the assumption has been violated or not. Of the six ANCOVAs that were conducted, one was found to have a significant interaction effect, which was for the SSQN factor of the SSQ6, which has violated the assumption of homogeneity of regression slopes. The assumption was satisfied for all other outcome measures however (see Table 3.15).

Table 3.15

Homogeneity of regression slopes test using ANCOVA interaction between study condition and covariates

Outcome variable	ANCOVA interaction effect
SSQN	$F(2, 43) = 5.36, p = .008$
SSQS	$F(2, 43) = 1.29, p = .287$
SEEHS	$F(2, 42) = 1.68, p = .200$
Moderate-intensity physical activity	$F(2, 43) = 1.17, p = .321$
Vigorous-intensity physical activity	$F(2, 43) = 0.19, p = .825$
Total physical activity	$F(2, 43) = 0.32, p = .726$
Physical activity frequency	$F(2, 43) = 0.39, p = .678$

Note. SSQN = Social Support Questionnaire number score; SSQS = Social Support Questionnaire satisfaction score; SEEHS = Self-Efficacy and Exercise Habits Survey.

It is suggested that violating the homogeneity of regression slopes assumption does not necessarily mean that ANCOVA cannot be conducted. Earlier simulation research by Peckham (1968) and Glass, Peckham, and Sanders (1972) suggests that for a one-factor fixed-effect model, the effect of heterogeneous regression slopes will be minimal. Furthermore, Harwell (2003) argued that the effect of non-homogenous regression slopes on the F -test is modest where there are unequal covariate means (such as in nonrandomized studies) and where the number of participants between conditions are unequal. Therefore, an ANCOVA including the SSQN as a dependent variable was conducted.

3.4.3. Inferential analysis.

In order to test each dependent variable that was under investigation, each inferential test was carried out seven times (to include SSQN, SSQS, SEEHS, moderate-, vigorous-, total physical activity, and frequency of physical activity); the outcomes of these tests are presented in the same order as that was used when describing descriptive data and data screening procedures. Specifically, in the following order: Social support (divided into SSQN and SSQS sub-sections), self-efficacy, moderate-intensity physical activity, vigorous-intensity physical activity, total physical activity and, lastly, the frequency of physical activity. Effect size measurements (partial η^2 , Cohen's d , and Pearson's r) have been included; for interpretation, the conventions (Clark-Carter, 2002; Cohen, 1988; Field, 2017) for the effect size are small ($\eta^2 = .01$, $d = 0.2$, $r = .10$), medium ($\eta^2 = .06$, $d = 0.5$, $r = .30$) and large ($\eta^2 = .14$, $d = 0.8$, $r = .50$).

3.4.3.1. Magnitude-based inferences.

The use of null hypothesis significance testing (NHST) is, however, flawed, as described by Batterham and Hopkins (2005) interpreting significance values at a $p < .05$ level does not produce useful information. For example, an outcome of $p < .05$ may represent an effect that is irrelevant in practice or clinical use for example and conversely, an effect that is $p > .05$ may indeed represent a worthwhile effect which would traditionally be otherwise dismissed as unimportant. As Cumming (2014) explains, presently the use of NHST leads to a dichotomy of thought, either an effect is important or not important and therefore, this perspective leads to an oversimplification of the reporting of and interpretation of statistical analyses.

Suffice it to say it is suggested that reliance on p may lead to erroneous interpretations.

MBI has typically been used within sport- and exercise science; however its application in behavioural sciences and psychology has been argued for (van Schaik & Weston, 2016). MBI is beneficial to use in conjunction with NHST as it produces rich information that is comprised of probabilities demonstrating that the true value will have the observed magnitude and lies within one of the three magnitudes (negative/harmful, negligible/trivial, or positive/beneficial). These are supplemented with appropriate and meaningful qualitative statements named mechanistic inferences. Mechanistic inferences use the terminology positive/trivial/negative to describe the direction of the outcome as well as include descriptors that are used to qualify these outcomes such as almost certainly, probably, and very likely, that represents the likelihood that the true value will have the observed magnitude. Because these statements are probabilistic (e.g., almost, probably) in nature rather than definitive statements (e.g., will, is) they are not burdened by Type I or Type II errors (Batterham & Hopkins, 2005). This is because false-positives (Type I error) and false-negatives (Type II error) cannot occur without a definitive acceptance or rejection of the null hypothesis, and the qualitative inferences that MBIs provide state the probabilistic direction of an effect but not whether or not an effect is significant.

Qualitative clinical inferences can be generated as well, which allows for appropriate health-related inferences to be made. An example of this occurs when testing a potentially harmful treatment, such as a nutritional supplement; to decide which treatment to use in practice, a researcher would need to know what the probabilities of a beneficial and a harmful outcome will be and consequently, if the

probability of benefit is sufficiently large enough to accept some risk or not (Hopkins, 2007). Both types of qualitative inference (mechanistic and clinical) stipulate the chance that an effect is negative/harmful, negligible/trivial, or positive/beneficial. However, they differ in that mechanistic inference describes an effect as unclear if the 90% confidence interval of the effect overlaps values that are substantial in a positive and negative sense. A clinical inference is, however, described as unclear if its probability of a positive effect is at least favourable (greater than the suggested 25% cut-off for a Type II error), but simultaneously the risk of harm is considered unacceptable (greater than the suggested 0.5% cut-off for a Type I error [van Schaik & Weston, 2016]). If an unclear inference is made then qualitative descriptors may still be applied to the upper and lower ends of the confidence interval to define the likely range of the effect (Hopkins, Batterham, Marshall, & Hanin, 2009; van Schaik & Weston, 2016; Weston, Taylor, Batterham, & Hopkins, 2005).

Hopkins (2007) recommends to always provide the qualitative mechanistic inferences. However, in instances with a direct application to health or performance, as is potentially the case in the present study (increasing the quantity and/or frequency of physical activity), then providing the qualitative clinical inferences in addition is appropriate.

Therefore, MBIs were calculated using the simple contrasts conducted from the 3×2 mixed ANOVA tests (see Section 3.4.3.2.) and ANCOVA tests (see Section 3.4.3.8.), irrespective of the significance of the overall main effects, the outcomes of which are presented after their respective inferential test. Each MBI was made with reference to the smallest worthwhile change, this was calculated by multiplying the pooled variance of each comparison by 0.2. The calculated values

for the smallest worthwhile change for each comparison can be found in Appendix J. The probability of substantial positive, trivial, or negative effects were assessed qualitatively as follows: < 0.5%, almost certainly not; 0.5% to 5%, very unlikely; 5% to 25%, unlikely; 25% to 75%, possibly; 75% to 95%, likely; 95% to 99.5%, very likely; > 95.5%, almost certainly.

In mechanistic inferences, if the probability of having a positive and negative effect were both > 5% in a singular comparison then the true difference was considered to be unclear (Hopkins et al., 2009). For use in clinical settings, inferences are made based on probabilities of harm and benefit with greater importance placed on the avoidance of using a harmful effect instead of failing to utilise a beneficial effect. As such, an effect is considered to be clinically beneficial when the probability of harm is < 0.5% (most unlikely) and > 25% (possible) for benefit. An unclear effect for clinical inference is defined as an effect that is possibly beneficial (> 25%) with an unacceptable (> 0.5%) risk of harm (Hopkins et al., 2009; van Schaik & Weston, 2016).

3.4.3.2. Mixed ANOVA.

A 3×2 (study condition × measurement point) mixed ANOVA design was employed where study condition (group, solo, or control) was the between-subjects factor and measurement time point (initial and week eight measurements) was the within-subjects factor. The purpose of mixed ANOVA was to test hypotheses H_{1a-d} . Therefore, a set of planned comparisons using simple contrasts were conducted for each mixed ANOVA which compared the group study condition with the solo study condition. In addition, the interactions between treatment (study condition) and time (initial and week eight measurement) are also reported.

3.4.3.3. Social support.

3.4.3.3.1. SSQN.

The main effect of measurement time point on SSQN score was significant, $F(1, 46) = 5.71$, $p = .021$, partial $\eta^2 = .11$. SSQN score significantly increased from initial measurement ($M = 3.77$; $SD = 1.77$) to week eight ($M = 4.25$; $SD = 2.12$).

The effect of study condition was non-significant, $F(2, 46) = 0.47$, $p = .630$, partial $\eta^2 = .02$, indicating that SSQN score did not differ between study conditions. The planned contrast comparing the group and solo study conditions, was non-significant, $t(46) = 1.09$, $p = .281$, $r = .16$, indicating that the group study condition ($M = 4.61$; $SD = 1.93$) and the solo study condition ($M = 3.81$; $SD = 2.13$) did not differ in SSQN mean score.

There was a non-significant interaction effect between measurement time point and study condition on SSQN score, $F(2, 46) = 1.75$, $p = .185$, partial $\eta^2 = .07$, therefore changes in SSQN score over time did not differ between study conditions.

3.4.3.3.2. SSQS.

The main effect of measurement time point on SSQS score non-significant, $F(1, 46) = 0.43$, $p = .518$, partial $\eta^2 = .01$. SSQS score did not significantly change from initial measurement ($M = 5.24$; $SD = .69$) to week eight ($M = 5.29$; $SD = .79$).

The effect of study condition was non-significant, $F(2, 46) = 0.92$, $p = .407$, partial $\eta^2 = .04$, indicating that SSQS score did not differ between study conditions. The planned contrast comparing the group and solo study conditions, was non-significant, $t(46) = 1.74$, $p = .089$, $r = .25$, indicating that the group study condition

($M = 5.51$; $SD = 0.57$) and the solo study condition ($M = 5.05$; $SD = 0.94$) did not differ in SSQS mean score.

There was a non-significant interaction effect between measurement time point and study condition on SSQS score, $F(2, 46) = 1.26$, $p = .295$, partial $\eta^2 = .05$, therefore changes in SSQS score over time did not differ between study conditions.

3.4.3.4. Self-efficacy.

The main effect of measurement time point on SEEHS score was significant, $F(1, 45) = 13.39$, $p = .001$, partial $\eta^2 = .23$. SEEHS score significantly increased from initial measurement ($M = 3.10$; $SD = .54$) to week eight ($M = 3.48$; $SD = .70$).

The effect of study condition was non-significant, $F(2, 45) = .81$, $p = .452$, partial $\eta^2 = .04$, indicating that SEEHS score did not differ between study conditions. The planned contrast comparing the group and solo study conditions, was non-significant, $t(46) = -0.02$, $p = .982$, $r = .00$, indicating that the group study condition ($M = 3.60$; $SD = 0.75$) and the solo study condition ($M = 3.61$; $SD = 0.71$) did not differ in SEEHS mean score.

There was a non-significant interaction effect between measurement time point and study condition on SEEHS score, $F(2, 45) = 1.64$, $p = .206$, partial $\eta^2 = .07$, therefore changes in SEEHS score over time did not differ between study conditions.

3.4.3.5. Physical activity.

3.4.3.5.1. Moderate-intensity physical activity.

The main effect of the measurement time point on moderate-intensity physical activity was non-significant, $F(1, 46) = 0.67$, $p = .417$, partial $\eta^2 = .01$. The quantity of moderate-intensity physical activity that was engaged in did not significantly change from initial measurement ($M = 48.78$; $SD = 45.68$) to week eight ($M = 53.98$; $SD = 56.04$).

The effect of study condition was non-significant, $F(2, 46) = 0.62$, $p = .544$, partial $\eta^2 = .03$, indicating that moderate-intensity physical activity did not differ between study conditions. The planned contrast comparing the group and solo study conditions, was non-significant, $t(46) = 0.85$, $p = .400$, $r = .12$, indicating that the group study condition ($M = 57.81$; $SD = 61.07$) and the solo study condition ($M = 41.39$; $SD = 42.18$) did not differ in the quantity of moderate-intensity physical activity that was engaged in.

There was a non-significant interaction effect between measurement time point and study condition on the number of minutes of moderate-intensity physical activity engaged in, $F(2, 46) = 0.37$, $p = .694$, partial $\eta^2 = .02$, therefore changes in moderate-intensity physical activity over time did not differ between study condition.

3.4.3.5.2. *Vigorous-intensity physical activity.*

The main effect of measurement time point on vigorous-intensity physical activity was non-significant, $F(1, 46) = 0.01$, $p = .925$, partial $\eta^2 = .00$. This indicates that the quantity of vigorous-intensity physical activity that was engaged in did not significantly change during the intervention from initial measurement ($M = 18.98$; $SD = 31.16$) to week eight ($M = 18.57$; $SD = 32.85$).

The effect of study condition was non-significant, $F(2, 46) = 1.36$, $p = .268$, partial $\eta^2 = .06$, indicating that vigorous-intensity physical activity did not differ between study conditions. The planned contrast comparing the group and solo study conditions, was non-significant, $t(46) = 1.79$, $p = .080$, $r = .26$, indicating that the group study condition ($M = 31.25$; $SD = 48.84$) and the solo study condition ($M = 11.39$; $SD = 18.22$) did not differ in the quantity of vigorous-intensity physical activity that was engaged in.

There was a non-significant interaction effect between measurement time point and study condition on the number of minutes of vigorous-intensity physical activity engaged in, $F(2, 46) = 0.83$, $p = .444$, partial $\eta^2 = .04$, therefore changes in vigorous-intensity physical activity over time did not differ between study condition.

3.4.3.5.3. *Total quantity of physical activity.*

The main effect of measurement time point on the total quantity of physical activity was non-significant, $F(1, 46) = 0.36$, $p = .554$, partial $\eta^2 = .01$. This indicates that the quantity of physical activity that was engaged in did not significantly change during the intervention from initial measurement ($M = 67.76$; $SD = 64.95$) to week eight ($M = 72.55$; $SD = 67.50$).

The effect of study condition was non-significant, $F(2, 46) = 0.93$, $p = .401$, partial $\eta^2 = .04$, indicating that total quantity of physical activity did not differ between study conditions. The planned contrast comparing the group and solo study conditions, was non-significant, $t(46) = 1.58$, $p = .122$, $r = .23$, indicating that the group study condition ($M = 89.06$; $SD = 82.22$) and the solo study condition ($M = 52.78$; $SD = 45.61$) did not differ in the total quantity of physical activity that was engaged in.

There was a non-significant interaction effect between measurement time point and study condition on the total number of minutes of physical activity engaged in, $F(2, 46) = 0.66$, $p = .524$, partial $\eta^2 = .03$, therefore changes in total physical activity over time did not differ between study condition.

3.4.3.5.4. *Frequency of physical activity.*

The main effect of measurement time point on the frequency of physical activity was non-significant, $F(1, 46) = 0.02$, $p = .882$, partial $\eta^2 = .00$. This indicates that the frequency that physical activity was engaged in did not significantly change during the intervention from initial measurement ($M = 1.92$; $SD = 1.41$) to week eight ($M = 1.94$; $SD = 1.45$).

The effect of study condition was non-significant, $F(2, 46) = 0.23$, $p = .799$, partial $\eta^2 = .01$, indicating that the frequency of physical activity did not differ between study conditions. The planned contrast comparing the group and solo study conditions, was non-significant, $t(46) = 1.09$, $p = .280$, $r = .16$, indicating that the group study condition ($M = 2.38$; $SD = 1.67$) and the solo study condition ($M = 1.83$; $SD = 1.43$) did not differ in the frequency of engagement in physical activity.

There was a significant interaction effect between measurement time point and study condition on the frequency that physical activity was engaged in, $F(2, 46) = 3.79$, $p = .030$, partial $\eta^2 = .14$, therefore changes in the frequency of physical activity over time did differ between study condition. The interaction graph (see Appendix K) shows that for both the solo and control study conditions the frequency of physical activity decreases between the initial and week eight measurements (more so for the control study condition). Additionally, the group study condition increases in frequency of physical activity between the initial and week eight measurements.

3.4.3.6. MBIs for 3×2 mixed ANOVA.

Tables 3.16 and 3.17 describe the MBIs that were calculated to supplement the conducted 3×2 mixed ANOVAs that were carried out to test hypotheses H_{1a-d} by providing further probabilistic information. Table 3.16 presents the quantitative outcomes of the MBIs and the associated qualitative mechanistic inferences. Table 3.17 presents the associated qualitative clinical inferences for each of the MBIs in Table 3.16.

Table 3.16

Magnitude-based mechanistic inferences calculated from simple contrasts from 3×2 mixed ANOVA

Outcome variables	Raw data; mean ± (SD)		% probability of positive/negligible/negative	ES	Between-condition differences	
	Group	Solo			%; ±90% CL	Qualitative mechanistic inference
SSQN	4.61 ± (1.93)	3.81 ± (2.13)	69.3/25.7/5.0	.16	0.8; ±1.2	Unclear; get more data.
SSQS	5.51 ± (0.57)	5.05 ± (0.94)	89.0/9.5/1.5	.25	0.46; ±0.45	Likely positive
SEEHS	3.60 ± (0.75)	3.61 ± (0.71)	27.4/43.7/28.9	.00	-0.01; ±0.38	Unclear; get more data.
Moderate PA	57.81 ± (61.07)	41.39 ± (42.18)	57.7/35.3/7.0	.12	16.42; ±32	Unclear; get more data.
Vigorous PA	31.25 ± (48.84)	11.39 ± (18.21)	86.2/13.0/0.8	.26	19.86; ±19	Likely positive
Total PA	89.06 ± (82.22)	52.78 ± (45.61)	81.6/16.9/1.5	.23	36.28; ±39	Likely positive
PA frequency	2.38 ± (1.67)	1.83 ± (1.42)	69.2/25.8/5.0	.16	0.54; ±0.83	Possibly positive

Note. SSQN = Social Support Questionnaire number score; SSQS = Social Support Questionnaire satisfaction score; SEEHS = Self-Efficacy and Exercise Habits Survey; PA = physical activity; ES = effect size (*r*); CL = confidence limits; ±90% CL: add and subtract this number to the mean effect to obtain the 90% confidence limits for the true difference; dividers between outcome variables included for clarity.

Table 3.17

Qualitative clinical inferences of MBIs performed in Table 3.16

Outcome variables	Qualitative clinical inferences for group study condition
SSQN	Unclear; don't use ; get more data.
SSQS	Likely beneficial, very unlikely harmful; use .
SEEHS	Unclear; don't use ; get more data.
Moderate PA	Unclear; don't use ; get more data.
Vigorous PA	Likely beneficial, very unlikely harmful; use .
Total PA	Likely beneficial, very unlikely harmful; use .
PA frequency	Unclear; don't use ; get more data.

Note. SSQN = Social Support Questionnaire number score; SSQS = Social Support Questionnaire satisfaction score; SEEHS = Self-Efficacy and Exercise Habits Survey; PA = physical activity.

3.4.3.7. Summary of 3×2 mixed ANOVA and associated MBIs.

Of the seven conducted 3×2 mixed ANOVA tests significant differences of the main effect (measurement time point on outcome) were found for the SSQN and SEEHS outcomes. Additionally, a significant interaction effect was found when testing the frequency of physical activity outcome. All other tested effects (the effect of the study condition, planned comparisons, and interaction) were found to be non-significant.

To provide further rich information on the outcome of the 3×2 mixed ANOVA testing, MBIs were performed (Tables 3.16 and 3.17). The findings presented in Table 3.16, describe the comparisons involving the SSQS, vigorous-intensity physical activity, total physical activity, and the frequency of physical activity outcomes as being likely to be positive (between 75%-95% probability), with the

exception of the frequency of physical activity outcome which was inferred to be possibly positive (between 25%-75% probability). The remaining three inferences that involved the SSQN, SEEHS, and moderate-intensity physical activity outcomes were considered for further data collection as the inference was unclear.

The clinical inferences (Table 3.17) may be more meaningful practically speaking; when comparing the group and solo study conditions, the group intervention was recommended for use for the SSQS, vigorous-intensity physical activity, and total physical activity outcomes in which they were considered to be likely beneficial and very unlikely to be harmful. The group intervention was not recommended for use when compared to the solo study condition for the remaining outcomes due to the inferences being unclear and requiring additional data as opposed to being outright harmful.

H_{1a-d} stated that sociable computer game play would increase social support, self-efficacy, and physical activity (moderate-intensity, vigorous-intensity, total, and the frequency of physical activity) over time more so than solo activity. Following 3×2 mixed ANOVA, H_{1a}, H_{1b}, H_{1c} have each been rejected due to the non-significance of their respective tests of interaction but also due to the non-significance of the simple contrasts that were made between the group and solo study conditions for each dependent variable. H_{1d}, however, has been accepted, due to the identification of a significant interaction effect (See Appendix K for interaction graph) in which sociable computer game play increased the frequency of physical activity across the duration of the intervention whereas solo and no computer game play reduced it.

See Table 3.27 (Section 3.4.4.) for a summary of the outcome of 3×2 mixed ANOVA testing on hypotheses H_{1a-d} , which are supported with their associated qualitative mechanistic and clinical inferences from MBI testing.

3.4.3.8. ANCOVA.

Each of the study's outcome variables (SSQN, SSQS, SEEHS, moderate-intensity, vigorous-intensity, total, and frequency of physical activity) were involved in an ANCOVA. The covariates that were included within the ANCOVA testing were the initial measurements recorded for each outcome variable. Specifically, initial measurement refers to baseline data for the SSQ6 (SSQN and SSQS) and the SEEHS; however, as measurements of baseline data were not taken in the control study condition the initial measurement refers to week one data for the SSQ6 and the SEEHS for control participants. For physical activity outcomes, initial measurement is from week one data for all of the study conditions.

The justification for including initial measurements as covariates for ANCOVA was to account for the potential confounding effect of participant's levels of social support, self-efficacy, and physical activity prior to experimental manipulation. It is plausible to consider that an individual's initial scores of social support, for example, may influence social support levels after intervention; statistically controlling for this through ANCOVA removes the bias of these variables.

ANCOVA was used to test hypotheses H_{2a-d} , which stated that social support, self-efficacy, and/or physical activity would be greater following specifically sociable computer game play in comparison to both solo and no computer game play. As such comparisons were made to first, compare sociable computer game play with solo computer game play, and second, to compare solo computer game play with no computer game play. The purpose of which was to establish that computer

game play in general is not facilitative of positive health-related behaviour change but, rather, that sociable computer game play is.

3.4.3.9. Social support.

3.4.3.9.1. SSQN.

The covariate, initial SSQN score, was significantly related to the week eight SSQN score, $F(1, 45) = 59.35, p < .001, r = .75$. There was a non-significant effect of study condition on week eight SSQS score after controlling for the effect of initial SSQS score, $F(2, 45) = 1.62, p = .210$, partial $\eta^2 = .07$.

Simple planned contrasts revealed that group activity ($M = 4.61$; $SD = 1.93$) did not significantly differ in SSQN score when compared to solo activity ($M = 3.81$; $SD = 2.13$), $t(45) = 1.61, p = .115, r = .23$, and solo activity did not significantly differ in SSQN score when compared to no activity (the control group; $M = 4.39$; $SD = 2.34$), $t(45) = -0.02, p = .984, r = .00$.

3.4.3.9.2. SSQS.

The covariate, initial SSQS score, was significantly related to the week eight SSQS score, $F(1, 45) = 48.95, p < .001, r = .72$. There was a non-significant effect of study condition on week eight SSQS score after controlling for the effect of initial SSQS score, $F(2, 45) = 1.62, p = .209$, partial $\eta^2 = .07$.

Simple planned contrasts revealed that group activity ($M = 5.51$; $SD = 0.57$) did not significantly differ in SSQN score when compared to solo activity ($M = 5.05$; $SD = 0.94$), $t(45) = 1.77, p = .084, r = .26$, and solo activity did not significantly differ in SSQN score when compared to no activity ($M = 5.35$; $SD = 0.75$), $t(45) = -1.12, p = .269, r = .16$.

3.4.3.10. Self-efficacy.

The covariate, baseline SEEHS score, was significantly related to the week eight SEEHS score, $F(1, 44) = 6.65$, $p = .013$, $r = .36$. There was a non-significant effect of study condition on week eight SEEHS score after controlling for the effect of baseline SEEHS score, $F(2, 44) = 1.96$, $p = .152$, partial $\eta^2 = .08$.

Simple planned contrasts revealed that group activity ($M = 3.60$; $SD = 0.75$) did not significantly differ in SSQN score when compared to solo activity ($M = 3.61$; $SD = 0.73$), $t(45) = -0.11$, $p = .914$, $r = .02$, and solo activity did not significantly differ in SSQN score when compared to no activity ($M = 3.21$; $SD = 0.56$), $t(44) = 1.79$, $p = .080$, $r = .26$.

3.4.3.11. Physical activity.

3.4.3.11.1. Moderate-intensity physical activity.

The covariate, week one moderate-intensity physical activity, was significantly related to week eight moderate-intensity physical activity, $F(1, 45) = 22.77$, $p < .001$, $r = .58$. There was a non-significant effect of study condition on week eight moderate-intensity physical activity after controlling for the effect of week one moderate-intensity physical activity, $F(2, 45) = .56$, $p = .576$, partial $\eta^2 = .02$.

Simple planned contrasts revealed that group activity ($M = 57.81$; $SD = 61.07$) did not significantly differ in moderate-intensity physical activity when compared to solo activity ($M = 41.39$; $SD = 42.18$), $t(45) = 0.84$, $p = .404$, $r = .12$, and solo activity did not significantly differ in moderate-intensity physical activity when compared to no activity ($M = 65.00$; $SD = 65.27$), $t(45) = -0.96$, $p = .345$, $r = .14$.

3.4.3.11.2. Vigorous-intensity physical activity.

The covariate, week one vigorous-intensity physical activity, was significantly related to week eight vigorous-intensity physical activity, $F(1, 45) = 4.73$, $p = .035$, $r = .31$. There was a non-significant effect of study condition on week eight vigorous-intensity physical activity after controlling for the effect of week one vigorous-intensity physical activity, $F(2, 45) = 1.64$, $p = .205$, partial $\eta^2 = .07$.

Simple planned contrasts revealed that group activity ($M = 31.25$; $SD = 48.84$) did not significantly differ in vigorous-intensity physical activity when compared to solo activity ($M = 11.39$; $SD = 18.22$), $t(45) = 1.58$, $p = .122$, $r = .23$, and solo activity did not significantly differ in vigorous-intensity physical activity when compared to no activity ($M = 13.67$; $SD = 21.59$), $t(45) = -0.04$, $p = .967$, $r = .01$.

3.4.3.11.3. Total quantity of physical activity.

The covariate, week one total physical activity, was significantly related to week eight total physical activity, $F(1, 45) = 24.59$, $p < .001$, $r = .59$. There was a non-significant effect of study condition on week eight total physical activity after controlling for the effect of week one total physical activity, $F(2, 45) = 1.12$, $p = .334$, partial $\eta^2 = .05$.

Simple planned contrasts revealed that group activity ($M = 89.06$; $SD = 82.22$) did not significantly differ in total physical activity when compared to solo activity ($M = 52.78$; $SD = 45.61$), $t(45) = 1.50$, $p = .141$, $r = .22$, and solo activity did not significantly differ in total physical activity when compared to no activity ($M = 78.67$; $SD = 70.70$), $t(45) = -0.71$, $p = .479$, $r = .11$.

3.4.3.11.4. *Frequency of physical activity.*

The covariate, week one physical activity frequency, was significantly related to the week eight frequency of physical activity, $F(1, 45) = 66.00, p < .001, r = .77$.

There was a significant effect of study condition on week eight frequency of physical activity after controlling for the effect of week one physical activity frequency, $F(2, 45) = 3.84, p = .029$, partial $\eta^2 = .15$.

Simple planned contrasts revealed that group activity ($M = 2.38; SD = 1.67$) engaged significantly more frequently in physical activity when compared to solo activity ($M = 1.83; SD = 1.43$), $t(45) = 2.15, p = .037, r = .31$, and solo activity did not significantly differ in frequency of physical activity when compared to no activity ($M = 1.60; SD = 1.18$), $t(45) = .559, p = .579, r = .08$.

3.4.3.12. *MBIs for ANCOVA.*

Tables 3.18 and 3.19 describe the MBIs that were calculated to test hypotheses H_{2a-d} , and involved simple planned contrasts that compared the group study condition with the solo study condition and the solo study condition with the control study condition. Table 3.18 presents the quantitative outcomes of the MBIs and the associated qualitative mechanistic inferences. Table 3.19 presents the qualitative clinical inferences for each of the MBIs in Table 3.18.

Table 3.18

Magnitude-based mechanistic inferences calculated from simple contrasts from ANCOVA

Outcome variables	IV conditions	Raw data; mean \pm (SD)			ES	Between-condition differences	
		Group or Control	Solo	% probability of positive/negligible/negative		%; $\pm 90\%$ CL	Qualitative mechanistic inference
SSQN	Group vs solo	4.61 \pm (1.93)	3.81 \pm (2.13)	78.2/20.8/1.0	.23	0.8; ± 0.84	Likely positive
	Solo vs control	4.39 \pm (2.34)		48.6/1.2/50.2	.00	-0.57; ± 49	Unclear; get more data
SSQS	Group vs solo	5.51 \pm (0.57)	5.05 \pm (0.94)	65.5/13.5/21.0	.26	0.46; ± 1.3	Unclear; get more data
	Solo vs control	5.35 \pm (0.75)		4.2/27.6/68.2	.16	-0.3; ± 0.45	Possibly negative
SEEHS	Group vs solo	3.60 \pm (0.75)	3.61 \pm (0.73)	0/100/0	.02	0.01; ± 0.01	Most likely trivial
	Solo vs control	3.21 \pm (0.56)		88.4/10.5/1.1	.26	0.41; ± 0.38	Likely positive
Moderate PA	Group vs solo	57.81 \pm (61.07)	41.39 \pm (42.18)	51.8/6.3/41.9	.12	16.42; ± 220	Unclear; get more data
	Solo vs control	65.00 \pm (65.27)		8.6/21.7/69.7	.14	-23.61; ± 42	Unclear; get more data
Vigorous PA	Group vs solo	31.25 \pm (48.84)	11.39 \pm (18.22)	83.8/14.3/1.9	.23	19.86; ± 21	Likely positive
	Solo vs control	13.67 \pm (21.59)		45.4/5.8/48.8	.01	-2.28; ± 91	Unclear; get more data
Total PA	Group vs solo	89.06 \pm (82.22)	52.78 \pm (45.61)	82.8/14.8/2.4	.22	36.28; ± 41	Likely positive
	Solo vs control	78.67 \pm (70.70)		15.3/19.5/65.2	.11	25.89; ± 61	Unclear; get more data
PA frequency	Group vs solo	2.38 \pm (1.67)	1.83 \pm (1.43)	82.4/17.5/0.1	.31	0.55; ± 0.43	Likely positive
	Solo vs control	1.60 \pm (1.18)		46.7/41.5/11.8	.08	0.23; ± 0.69	Unclear; get more data

Note. SSQN = Social Support Questionnaire number score; SSQS = Social Support Questionnaire satisfaction score; SEEHS = Self-Efficacy and Exercise Habits Survey; PA = physical activity; ES = effect size (r); CL = confidence limits; $\pm 90\%$ CL: add and subtract this number to the mean effect to obtain the 90% confidence limits for the true difference; dividers between outcome variables included for clarity.

Table 3.19

Qualitative clinical inferences of MBIs performed in Table 3.18

Outcome variables	IV condition comparison	Qualitative clinical inference
SSQN	Group vs solo	Likely beneficial, very unlikely harmful; use .
	Solo vs control	Unclear; don't use ; get more data.
SSQS	Group vs solo	Unclear; don't use ; get more data.
	Solo vs control	Possibly harmful, very unlikely beneficial; don't use .
Self-efficacy	Group vs solo	Most unlikely harmful, most unlikely beneficial; don't use .
	Solo vs control	Likely beneficial, very unlikely harmful; use .
Moderate PA	Group vs solo	Unclear; don't use ; get more data.
	Solo vs control	Possibly harmful, unlikely beneficial; don't use .
Vigorous PA	Group vs solo	Likely beneficial, very unlikely harmful; use .
	Solo vs control	Unclear; don't use ; get more data.
Total PA	Group vs solo	Likely beneficial, very unlikely harmful; use .
	Solo vs control	Possibly harmful, unlikely beneficial; don't use .
PA frequency	Group vs solo	Likely beneficial, most unlikely harmful; use .
	Solo vs control	Unclear; don't use ; get more data.

Note. SSQN = Social Support Questionnaire number score; SSQS = Social Support Questionnaire satisfaction score; PA = physical activity; dividers between outcome variables included for clarity.

3.4.3.13. Summary of ANCOVA and associated MBIs.

Each of the covariates (initial measurements) were found to be significantly related to their respective week eight measurements, which is in line with expectations.

The ANCOVA testing the effect of study condition on the frequency of physical activity found a significant effect, simple planned contrasts revealed that the group study condition ($M = 2.38$; $SD = 1.67$) engaged in physical activity on a more frequent basis when compared with the solo study condition ($M = 1.83$; $SD =$

1.43). All other ANCOVA yielded statistically non-significant results of study condition on outcome and planned contrasts.

Examining the findings of the MBIs, however, provides further rich information on the outcome of the ANCOVA testing and simple contrasts that were produced.

Qualitative mechanistic inferences (Table 3.18) found when comparing the group study condition to the solo study condition four instances of likely (between 75%-95% probability) positive effects of the intervention, which occurred when testing the SSQN, vigorous-intensity, total physical activity, and the frequency of physical activity outcomes. An inference of most likely to be trivial was made for the SEEHS outcome, and the inferences made for the SSQS and moderate-intensity physical activity outcomes were unclear with recommendations for further data collection. When comparing the solo study condition to the control there were two instances of clear inferences, which involved the SSQS (possibly negative) and SEEHS (likely positive) outcomes. The remaining inferences were considered to be unclear and recommended for further data collection.

The qualitative clinical inferences (Table 3.19) recommended the intervention for use when comparing the group and solo study conditions in four instances, this occurred for the same outcomes that had positive mechanistic inferences, and were each considered to be likely to be beneficial and either very unlikely or most unlikely to be harmful. The SEEHS outcome was considered to be most unlikely to be beneficial and most unlikely to be harmful and, as such, was not recommended for clinical use. The remaining outcomes, SSQS and moderate-intensity physical activity, were not recommended for use due to being unclear, as opposed to being outright harmful.

When comparing the solo study condition to the control study condition only the SEEHS outcome was considered for use being likely to be beneficial and very unlikely to be harmful, otherwise the inferences were unclear (SSQN, vigorous-intensity physical activity, and frequency of physical activity) or too harmful for use (SSQS, moderate-intensity physical activity, and total physical activity).

H_{2a-d} stated that specifically sociable computer game play would produce greater levels of social support, self-efficacy, or physical activity (moderate-intensity, vigorous-intensity, total, and the frequency of physical activity) when compared to no computer game play and non-sociable computer game play. Following ANCOVA, H_{2a}, H_{2b}, and H_{2c} have each been rejected due to the non-significance of the simple contrasts that were made between the group and solo study conditions. H_{2d}, on the other hand, has been accepted due to the significance of the simple contrast, in the stated direction, that was made between the group and solo study conditions when testing the frequency of physical activity outcome. Furthermore, ANCOVA findings provide some evidence in support of H_{2a-d} by indicating that the solo and control study conditions did not differ in any outcome measurement, which was predicted, due to the non-significance of comparisons between these two study conditions.

See Table 3.28 and Table 3.29 (Section 3.4.4.) for a summary of the outcome of ANCOVA testing on hypotheses H_{2a-d}, which are supported with their associated qualitative mechanistic and clinical inferences from MBI testing.

3.4.3.14. Mediation analysis.

To test hypothesis H₃ and the theoretically proposed mediation relationship (Figure 3.10.) between the dependent variables social support (as predictor), self-efficacy (as mediator), and physical activity (as outcome), mediation analyses were conducted using the PROCESS macro (Hayes, 2016) for SPSS. The analyses were conducted using the modern techniques outlined by Field (2017), Hayes (2018), and MacKinnon (2008) which tests the indirect effect of the relationship, that is, the effect of social support on physical activity outcomes through self-efficacy.

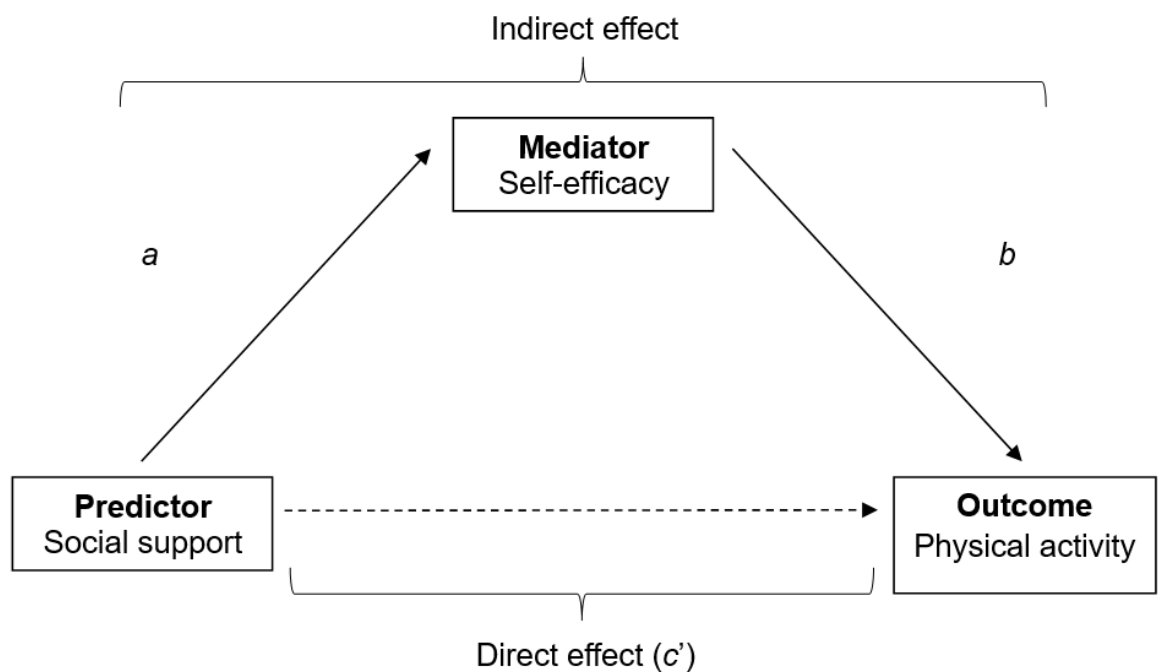


Figure 3.10. Proposed mediation model (Study 1).

The outcome of each mediation analysis was interpreted using Zhao et al.'s (2010) typology of mediations and non-mediations, which identifies three instances consistent with mediation, and two with non-mediation, see Table 3.20.

Table 3.20

Zhao et al.'s (2010) typology of mediations and non-mediations

Interpretation	Occurrence
Complementary mediation	$a \times b$ and c' both exist and point in the same direction.
Competitive mediation	$a \times b$ and c' both exist and point in the opposite direction.
Indirect-only mediation	$a \times b$ exists, c' does not exist.
Direct-only non-mediation	$a \times b$ does not exist, c' does exist.
No-effect non-mediation	Neither $a \times b$ or c' exist.

Note. $a \times b$ represents the indirect effect; c' represents the direct effect (Figure 3.10.).

A series of mediation analyses were conducted testing each of the study conditions, both factors of the SSQ6 (SSQN and SSQS), as well as each physical activity measurement (moderate-intensity, vigorous-intensity, total, and frequency of physical activity) as shown in Figure 3.10. The predictor (social support) used data from the week six SSQ6 measurements (SSQS or SSQN factors); the mediator (self-efficacy) used data from the week seven SEEHS measurements; and the outcome (physical activity measurements), used data from week eight of the intervention. The rationale for using these time points within the mediation analysis was that any changes experienced in social support would be expected to impact self-efficacy at the subsequent measurement point, and so on for physical activity (being affected by changes in self-efficacy).

As such, each mediation analysis was performed initially including SSQN as the predictor and again but with SSQS as the predictor; this procedure was repeated so that each physical activity measurement could be analysed as an outcome.

Each study condition was tested separately, this resulted in 24 mediation analyses being conducted.

3.4.3.14.1. Group study condition (SSQN).

For the group study condition there was a non-significant indirect effect of SSQN score on levels of moderate-intensity physical activity through self-efficacy, $b = 5.45$, BCa CI(95%) = [-0.60, 17.88], $R^2 = .15$, indicating that mediation did not occur.

There was a non-significant indirect effect of SSQN mean score on levels of vigorous-intensity physical activity through self-efficacy, $b = 6.90$, BCa CI(95%) = [-0.84, 20.12], $R^2 = .35$, indicating that mediation did not occur.

There was a non-significant indirect effect of SSQN mean score on total levels of physical activity through self-efficacy, $b = 12.35$, BCa CI(95%) = [-1.80, 33.56], $R^2 = .41$, indicating that mediation did not occur.

There was a non-significant indirect effect of SSQN mean score on the frequency of physical activity through self-efficacy, $b = 0.17$, BCa CI(95%) = [-0.04, 0.53], $R^2 = .16$, indicating that mediation did not occur.

The outcomes of these mediation analyses, including the unstandardised regression coefficients represented as a , b , and c' in Figure 3.10., are presented in Table 3.21.

Table 3.21

Unstandardised regression coefficients for the group study condition with SSQN as the predictor including interpretation of effects

Outcome	Indirect effect	a, b and direct effect (in respective order)	Interpretation (Zhao et al., 2010)
		$b = 0.15, p = .104$	
Mod PA	$b = 5.45$, BCa CI [-0.60, 17.88], $R^2 = .15$	$b = 37.42, p = .198$ $b = -1.07, p = .909$	No-effect Mediation
		$b = 0.15, p = .104$	
Vig PA	$b = 6.90$, BCa CI [-0.84, 20.12], $R^2 = .35$	$b = 47.42, p = .028$ $b = -4.28, p = .511$	No-effect Mediation
		$b = 0.15, p = .104$	
Total PA	$b = 12.35$, BCa CI [-1.80, 33.56], $R^2 = .41$	$b = 84.84, p = .017$ $b = -5.35, p = .611$	No-effect Mediation
		$b = 0.146, p = .104$	
PA freq	$b = 0.17$, BCa CI [-0.04, 0.53], $R^2 = .16$	$b = 1.133, p = .153$ $b = -0.134, p = .600$	No-effect Mediation

Note. Mod = moderate-intensity; Vig = vigorous-intensity; freq = frequency; PA = physical activity; the confidence interval for the indirect effect is a BCa bootstrapped CI based on 5,000 samples.

3.4.3.14.2. Group study condition (SSQS).

There was a significant negative indirect effect of SSQS mean score on levels of moderate physical activity through self-efficacy, $b = -13.64$, BCa CI(95%) = [-48.06, -0.11], $R^2 = .16$, indicating that mediation occurred.

There was a significant negative indirect effect of SSQS mean score on levels of vigorous physical activity through self-efficacy, $b = -14.89$, BCa CI(95%) = [-44.82, -1.03], $R^2 = .36$, indicating that mediation occurred.

There was a significant negative indirect effect of SSQS mean score on total levels of physical activity through self-efficacy, $b = -28.53$, BCa CI(95%) = [-79.37, -7.84], $R^2 = .42$, indicating that mediation occurred.

There was a non-significant indirect effect of SSQS mean score on the frequency of physical activity through self-efficacy, $b = -0.27$, BCa CI(95%) = [-1.06, 0.49], $R^2 = .20$, indicating that mediation did not occur.

The outcomes of these mediation analyses including the unstandardised regression coefficients represented as a , b , and c' in Figure 3.10., are presented in Table 3.22.

Table 3.22

Unstandardised regression coefficients for the group study condition with SSQS as the predictor including interpretation of effects

Outcome	Indirect effect	a, b and direct effect (in respective order)	Interpretation (Zhao et al., 2010)
		$b = -0.43, p = .073$	
Mod PA	$b = -13.64$, BCa CI [-48.06, -0.11], $R^2 = .16$	$b = 31.91, p = .276$ $b = -7.76, p = .763$	Indirect-only mediation
		$b = -0.43, p = .073$	
Vig PA	$b = -14.89$, BCa CI [-44.82, -1.03], $R^2 = .36$	$b = 34.84, p = .096$ $b = -13.17, p = .462$	Indirect-only mediation
		$b = -0.43, p = .073$	
Total PA	$b = -28.53$, BCa CI [-79.37, -7.84], $R^2 = .42$	$b = 66.75, p = .053$ $b = -20.93, p = .469$	Indirect-only mediation
		$b = -0.43, p = .073$	
PA freq	$b = -0.27$, BCa CI [-1.060, 0.488], $R^2 = .20$	$b = 0.64, p = .406$ $b = -0.60, p = .390$	No-effect mediation

Note. Mod = moderate-intensity; Vig = vigorous-intensity; freq = frequency; PA = physical activity; the confidence interval for the indirect effect is a BCa bootstrapped CI based on 5,000 samples.

3.4.3.14.3. Solo study condition (SSQN).

For the solo study condition there was a non-significant indirect effect of SSQN mean score on levels of moderate physical activity through self-efficacy, $b = -0.99$, BCa CI(95%) = [-8.30, 1.27], $R^2 = .11$, indicating that mediation did not occur.

There was a non-significant indirect effect of SSQN mean score on levels of vigorous physical activity through self-efficacy, $b = 0.68$, BCa CI(95%) = [-1.37, 6.74], $R^2 = .05$, indicating that mediation did not occur.

There was a non-significant indirect effect of SSQN mean score on total levels of physical activity through self-efficacy, $b = -0.31$, BCa CI(95%) = [-4.81, 5.57], $R^2 = .06$, indicating that mediation did not occur.

There was a non-significant indirect effect of SSQN mean score on the frequency of physical activity through self-efficacy, $b = -0.02$, BCa CI(95%) = [-0.19, 0.09], $R^2 = .18$, indicating that mediation did not occur.

The outcomes of these mediation analyses including the unstandardised regression coefficients represented as a , b , and c' in Figure 3.10., are presented in Table 3.23.

Table 3.23

Unstandardised regression coefficients for the solo study condition with SSQN as the predictor including interpretation of effects

Outcome	Indirect effect	a, b and direct effect (in respective order)	Interpretation (Zhao et al., 2010)
		$b = 0.11, p = .155$	
Mod PA	$b = -0.99$, BCa CI [-8.30, 1.27], $R^2 = .11$	$b = -8.89, p = .629$ $b = -5.62, p = .342$	No-effect mediation
		$b = 0.11, p = .155$	
Vig PA	$b = 0.68$, BCa CI [-1.37, 6.74], $R^2 = .05$	$b = 6.14, p = .455$ $b = 0.397, p = .878$	No-effect mediation
		$b = 0.11, p = .155$	
Total PA	$b = -0.31$, BCa CI [-4.81, 5.57], $R^2 = .06$	$b = -2.75, p = .893$ $b = -5.22, p = .425$	No-effect mediation
		$b = 0.11, p = .155$	
PA freq	$b = -0.02$, BCa CI [-0.19, 0.09], $R^2 = .18$	$b = -0.15, p = .803$ $b = -0.30, p = .128$	No-effect mediation

Note. Mod = moderate-intensity; Vig = vigorous-intensity; freq = frequency; PA = physical activity; the confidence interval for the indirect effect is a BCa bootstrapped CI based on 5,000 samples.

3.4.3.14.4. Solo study condition (SSQS).

There was a non-significant indirect effect of SSQS mean score on levels of moderate physical activity through self-efficacy, $b = -6.32$, BCa CI(95%) = [-40.71, 15.94], $R^2 = .05$, indicating that mediation did not occur.

There was a non-significant indirect effect of SSQS mean score on levels of vigorous physical activity through self-efficacy, $b = 3.08$, BCa CI(95%) = [-5.26, 21.99], $R^2 = .05$, indicating that mediation did not occur.

There was a non-significant indirect effect of SSQS mean score on total levels of physical activity through self-efficacy, $b = -3.24$, BCa CI(95%) = [-32.23, 28.88], $R^2 = .01$, indicating that mediation did not occur.

There was a non-significant indirect effect of SSQS mean score on the frequency of physical activity through self-efficacy, $b = -0.02$, BCa CI(95%) = [-0.61, 1.07], $R^2 = .16$, indicating that mediation did not occur.

The outcomes of these mediation analyses including the unstandardised regression coefficients represented as a , b , and c' in Figure 3.10., are presented in Table 3.24.

Table 3.24

Unstandardised regression coefficients for the solo study condition with SSQS as the predictor including interpretation of effects

Outcome	Indirect effect	a, b and direct effect (in respective order)	Interpretation (Zhao et al., 2010)
		$b = 0.42, p = .045$	
Mod PA	$b = -6.32$, BCa CI [-40.71, 15.94], $R^2 = .05$	$b = -15.17, p = .455$ $b = 0.19, p = .991$	No-effect mediation
		$b = 0.42, p = .045$	
Vig PA	$b = 3.08$, BCa CI [-5.26, 21.99], $R^2 = .05$	$b = 7.39, p = .400$ $b = -1.49, p = .845$	No-effect mediation
		$b = 0.42, p = .045$	
Total PA	$b = -3.24$, BCa CI [-32.23, 28.88], $R^2 = .01$	$b = -7.78, p = .726$ $b = -1.29, p = .947$	No-effect mediation
		$b = 0.42, p = .045$	
PA freq	$b = -0.02$, BCa CI [-0.607, 1.069], $R^2 = .16$	$b = -0.04, p = .946$ $b = -0.79, p = .171$	No-effect mediation

Note. Mod = moderate-intensity; Vig = vigorous-intensity; freq = frequency; PA = physical activity; the confidence interval for the indirect effect is a BCa bootstrapped CI based on 5,000 samples.

3.4.3.14.5. Control study condition (SSQN).

For the control study condition there was a non-significant indirect effect of SSQN mean score on levels of moderate physical activity through self-efficacy, $b = -1.39$, BCa CI(95%) = [-11.64, 3.81], $R^2 = .04$, indicating that mediation did not occur.

There was a non-significant indirect effect of SSQN mean score on levels of vigorous physical activity through self-efficacy, $b = -0.53$, BCa CI(95%) = [-7.04, 0.35], $R^2 = .11$, indicating that mediation did not occur.

There was a non-significant indirect effect of SSQN mean score on total levels of physical activity through self-efficacy, $b = -1.92$, BCa CI(95%) = [-14.80, 2.51], $R^2 = .05$, indicating that mediation did not occur.

There was a non-significant indirect effect of SSQN mean score on the frequency of physical activity through self-efficacy, $b = -0.003$, BCa CI(95%) = [-0.14, 0.17], $R^2 = .03$, indicating that mediation did not occur.

The outcomes of these mediation analyses including the unstandardised regression coefficients represented as a , b , and c' in Figure 3.10., are presented in Table 3.25.

Table 3.25

Unstandardised regression coefficients for the control study condition with SSQN as the predictor including interpretation of effects

Outcome	Indirect effect	a, b and direct effect (in respective order)	Interpretation (Zhao et al., 2010)
		$b = -0.10, p = .318$	
Mod PA	$b = -1.39$, BCa CI [-11.64, 3.81], $R^2 = .04$	$b = 14.42, p = .550$ $b = -0.28, p = .973$	No-effect mediation
		$b = -0.10, p = .318$	
Vig PA	$b = -0.53$, BCa CI [-7.04, 0.35], $R^2 = .11$	$b = 5.44, p = .536$ $b = 3.14, p = .295$	No-effect mediation
		$b = -0.10, p = .318$	
Total PA	$b = -1.92$, BCa CI [-14.80, 2.51], $R^2 = .05$	$b = 19.86, p = .459$ $b = -2.86, p = .748$	No-effect mediation
		$b = -0.10, p = .318$	
PA freq	$b = -0.003$, BCa CI [-0.14, 0.17], $R^2 = .03$	$b = 0.04, p = .941$ $b = -0.06, p = .579$	No-effect mediation

Note. Mod = moderate-intensity; Vig = vigorous-intensity; freq = frequency; PA = physical activity; the confidence interval for the indirect effect is a BCa bootstrapped CI based on 5,000 samples.

3.4.3.14.6. Control study condition (SSQS).

There was a non-significant indirect effect of SSQS mean score on levels of moderate physical activity through self-efficacy, $b = -2.49$, BCa CI(95%) = [-46.28, 13.08], $R^2 = .06$, indicating that mediation did not occur.

There was a non-significant indirect effect of SSQS mean score on levels of vigorous physical activity through self-efficacy, $b = -0.39$, BCa CI(95%) = [-13.24, 3.40], $R^2 = .03$, indicating that mediation did not occur.

There was a non-significant indirect effect of SSQS mean score on total levels of physical activity through self-efficacy, $b = -2.87$, BCa CI(95%) = [-59.46, 13.28], $R^2 = .08$, indicating that mediation did not occur.

There was a non-significant indirect effect of SSQS mean score on the frequency of physical activity through self-efficacy, $b = 0.03$, BCa CI(95%) = [-0.23, 0.76], $R^2 = .14$, indicating that mediation did not occur.

The outcomes of these mediation analyses including the unstandardised regression coefficients represented as a , b , and c' in Figure 3.10., are presented in Table 3.26.

Table 3.26

Unstandardised regression coefficients for the control study condition with SSQS as the predictor including interpretation of effects

Outcome	Indirect effect	a, b and direct effect (in respective order)	Interpretation (Zhao et al., 2010)
		$b = -0.20, p = .486$	
Mod PA	$b = -2.49$, BCa CI [-46.28, 13.08], $R^2 = .06$	$b = 12.32, p = .597$ $b = -11.44, p = .621$	No-effect mediation
		$b = -0.20, p = .486$	
Vig PA	$b = -0.39$, BCa CI [-13.24, 3.40], $R^2 = .03$	$b = 1.92, p = .830$ $b = -4.08, p = .646$	No-effect mediation
		$b = -0.20, p = .486$	
Total PA	$b = -2.87$, BCa CI [-59.46, 13.28], $R^2 = .08$	$b = 14.24, p = .581$ $b = -15.52, p = .546$	No-effect mediation
		$b = -0.20, p = .486$	
PA freq	$b = 0.03$, BCa CI [-0.225, 0.760], $R^2 = .14$	$b = -0.16, p = .721$ $b = -0.56, p = .211$	No-effect mediation

Note. Mod = moderate-intensity; Vig = vigorous-intensity; freq = frequency; PA = physical activity; the confidence interval for the indirect effect is a BCa bootstrapped CI based on 5,000 samples.

3.4.3.15. Summary of mediation analysis.

Of the 24 performed mediation analyses, 21 instances of no-effect mediation occurred (neither the indirect effect nor the direct effect were significant). However, three instances of indirect-only mediation, an indirect effect ($a \times b$) was identified but the direct effect (c') was not, occurred when testing the group study condition and the SSQS factor as the predictor for the moderate-intensity, vigorous-intensity, and total physical activity outcomes.

Hypothesis H₃ stated that self-efficacy would mediate the effect of social support on perceived stress, which is supported by the three identified instances of indirect-only mediation. To provide further information significant effects will be described to determine the direction of the relationship(s) between predictor, mediator, and outcome, starting with the instances of indirect only mediation.

With SSQS as the predictor in the group study condition the indirect effect was negative in each instance that indirect-only mediation occurred, suggesting that as the quantity of social support (SSQS) increased moderate-intensity, vigorous-intensity, and total physical activity decreased. However, the *b* pathway in the cases involving indirect-only mediation were positive indicating that as self-efficacy increased as did the physical activity outcomes.

Other significant effects that occurred were the *b* pathways for vigorous-intensity and total physical activity outcomes with SSQN as the predictor in the group study condition; both of which were positive, suggesting that as self-efficacy increased as did the respective physical activity outcome measurement. Furthermore, the *a* pathway was significant with SSQS as the predictor in the solo study condition which was positive, suggesting that as social support (SSQS) increased as did self-efficacy (SEEHS).

Consequently, the detection of indirect-only mediation does suggest that there may be a relationship between social support and physical activity that is mediated by self-efficacy thereby, providing support for H₄ leading to it being accepted.

3.4.4. Summary of results and hypotheses.

Based on the provided evidence, of the nine hypotheses that were proposed three have been accepted and six have been rejected. See Tables 3.27–3.29 for specific information regarding the acceptance/rejection of hypotheses, which are supported by their respective qualitative mechanistic and clinical inferences where relevant.

Study 1's discussion (Section 3.5.) contains further examination of these findings as well as a consideration of their implications. The present study's design and method will be evaluated as well to determine if any future improvements can be implemented in Study 2.

Table 3.27

Summary of Study 1 hypotheses - part 1; H_{1a-d} (NHST test: 3×2 mixed ANOVA, group vs solo study condition comparisons)

Hypotheses	Accept / reject Hypothesis	Outcome measure	Statistical Significance	Magnitude-based inferences	
				Mechanistic inference	Clinical inference
H_{1a} : Group activity increases social support over time more than solo activity does.	Reject	SSQN	Non-Significant	Unclear	Don't use
		SSQS	Non-significant	Likely positive	Use
H_{1b} : Group activity increases self-efficacy over time more than solo activity does.	Reject	SEEHS	Non-significant	Unclear	Don't use
H_{1c} : Group activity increases moderate-and/or vigorous-intensity physical activity over time more than solo activity does.	Reject	Mod PA	Non-significant	Unclear	Don't use
		Vig PA	Non-significant	Likely positive	Use
		Total PA	Non-significant	Likely positive	Use
H_{1d} : Group activity increases the frequency of physical activity over time more than solo activity does.	Accept	PA Freq	Non-significant*	Possibly positive	Don't use

Note. SSQN = Social Support Questionnaire number score; SSQS = Social Support Questionnaire satisfaction score; SEEHS = Self-Efficacy and Exercise Habits Survey; Mod = moderate-intensity; Vig = vigorous-intensity; Freq = frequency; PA = physical activity; dividers between hypotheses included for clarity. * = statistically significant interaction effect

Table 3.28

Summary of Study 1 hypotheses - part 2: H_{3a-d} (NHST test: ANCOVA, group vs solo and solo vs control study condition comparisons)

Hypotheses	Accept / reject Hypothesis	Outcome measure	Statistical Significance	Magnitude-based inferences	
				Mechanistic inference	Clinical inference
H _{2a} : Computer game play produces greater levels of social support when compared to no computer game play, but only when the computer game play is sociable.	Reject	SSQN	Non-Significant	Likely positive	Use
		SSQS	Non-significant	Unclear	Don't use
H _{2b} : Computer game play produces greater levels of self-efficacy when compared to no computer game play, but only when the computer game play is sociable.	Reject	SEEHS	Non-significant	Most likely trivial	Don't use
H _{2c} : Computer game play produces greater levels of moderate-and/or vigorous-intensity physical activity when compared to no computer game play, but only when the computer game play is sociable.	Reject	Mod PA	Non-significant	Unclear	Don't use
		Vig PA	Non-significant	Likely positive	Use
		Total PA	Non-significant	Likely positive	Use
H _{2d} : Computer game play produces greater frequency of physical activity when compared to no computer game play, but only when the computer game play is sociable.	Accept	PA Freq	Significant	Likely positive	Use

Note. SSQN = Social Support Questionnaire number score; SSQS = Social Support Questionnaire satisfaction score; SEEHS = Self-Efficacy and Exercise Habits Survey; Mod = moderate-intensity; Vig = vigorous-intensity; Freq = frequency; PA = physical activity; dividers between hypotheses included for clarity.

Table 3.29

Summary of Study 1 hypotheses - part 3: H₈ (Mediation analysis)

Hypothesis	Accept / reject H _#	Study condition	Predictor	Physical activity measure	Interpretation of mediation (Zhao et al., 2010)
H ₃ : Self-efficacy mediates the effect of social support on physical activity.	Accept	Group	SSQN	Moderate-intensity PA	No-effect mediation
				Vigorous-intensity PA	No-effect mediation
				Total PA	No-effect mediation
				PA Frequency	No-effect mediation
			SSQS	Moderate-intensity PA	Indirect-only mediation
				Vigorous-intensity PA	Indirect-only mediation
				Total PA	Indirect-only mediation
				PA Frequency	No-effect mediation
		Solo	SSQN	Moderate-intensity PA	No-effect mediation
				Vigorous-intensity PA	No-effect mediation
				Total PA	No-effect mediation
				PA Frequency	No-effect mediation
			SSQS	Moderate-intensity PA	No-effect mediation
				Vigorous-intensity PA	No-effect mediation
				Total PA	No-effect mediation
				PA Frequency	No-effect mediation
		Control	SSQN	Moderate-intensity PA	No-effect mediation
				Vigorous-intensity PA	No-effect mediation
				Total PA	No-effect mediation
				PA Frequency	No-effect mediation
			SSQS	Moderate-intensity PA	No-effect mediation
				Vigorous-intensity PA	No-effect mediation
				Total PA	No-effect mediation
				PA Frequency	No-effect mediation

Note. SSQN = Social Support Questionnaire number score; SSQS = Social Support Questionnaire satisfaction score; PA = physical activity; dividers between series of mediation analyses included for clarity.

3.5. Discussion - Study 1

A number of subheadings are presented below in order to suitably structure a step-by-step process of inquiry into the merits and drawbacks that are specific to Study 1. This process is initiated with commentary regarding the study's design, method, and analytical strategy. This is followed by a discussion of the study's findings, which are applied to the broader psychological literature. Consideration is made regarding the original contribution to knowledge that this study has made as well as potential future directions of inquiry made possible by this research. Lastly, following the above described evaluation of Study 1, an account of potential improvements that could be made to the design, method, or analytical strategy are presented for consideration in future research

3.5.1. Discussion of design, method, and analysis.

This section discusses the merits and limitations of the design, method, and data analysis that was used/performed in the present study. This is important to consider to help determine if the described outcomes of the study are attributable to the intervention and, consequently, the performed experimental manipulation or if confounding variables, for example, may be more explanative of the findings instead.

3.5.1.1. Design.

In the initial design of Study 1 it was stipulated that the group study condition required four participants to participate in each 'team'. This stipulation was in place only for the first team that was recruited into the study, which was later revised. The revised requirements for the formation of a team of participants, allocated to the group study condition, was between two-to-four participants instead of strictly

four. The justification for this change was the challenge of recruiting participants into the group study condition. This challenge arose due to the long-term design of the study: taking part took eight weeks and required group study condition participants to attend laboratory sessions simultaneously on a once-weekly basis at the same time, which was likely to lead to timetabling issues between four individuals. It was common for two or three individuals to arrange participation during the same time; however, this was insufficient to form a team before this change was implemented. Implementing this change led to the successful population of the group study condition whilst still maintaining its goal, to provide an opportunity to measure the effect of sociable computer game play on social support, self-efficacy, and physical activity.

Participation in the present study occurring weekly over a period of eight weeks, unfortunately, resulted in study participation necessarily being postponed in certain circumstances. Postponement of participation typically occurred around breaks in university semesters as it was common for participants, who were students, to move to their out-of-semester accommodation. In these instances the postponement of participation meant that upon returning to the university participants would continue their participation in the study as normal, meaning that eight weeks of data collection for each participant was still achieved. However, it is possible that study postponement as described may have influenced the collected data to some degree. For example, students who went home to family over the Christmas period may have experienced more social support or engaged in less physical activity than they normally would. The potential magnitude that study postponement may have had upon the data remains unclear; however, through

the rigorously performed data-screening process any noteworthy changes resulting in statistical outliers will have been detected.

3.5.1.2. Method.

Inclusion and exclusion criteria appeared to successfully prevent participation, or in some cases assisted identification, of participants by screening them for proscribed physical activity habits. These were engaging in greater quantities of physical activity as recommended by the NHS and WHO, and/or being a member of any group-based physical activity communities. Eight instances occurred involving the recruitment of participants who regularly exceeded the limits of physical activity at 75% or more of measurement points. This error occurred as participants recorded either erroneous information regarding their physical activity habits at their initial baseline measurement or had simply not engaged in physical activity that week but returned to their normal quantity of physical activity in following weeks which violated the inclusion criteria. This was later detected when the data set was subjected to data screening procedures resulting in such participant's information being expunged from the data set. This could have been detected sooner, thereby avoiding time wastage and identifying the need for further participant recruitment to replace the cases that were removed, by inspecting physical activity values after each laboratory session.

A number of rooms were used during the time that the study was conducted; this was out of necessity, as rooms were often needed for other purposes such as teaching, maintenance, and other research projects, for example. The rooms used within the study included general purpose teaching rooms, computer laboratories, and psychology experiment laboratories. Each of these rooms are likely to have

varied in their ambient temperature, due to possibly being thermostatically controlled, or due to the presence of computers, for example. Furthermore, lighting is likely to have varied as well due to some rooms having natural lighting from windows whereas other rooms had only artificial lighting. Potentially, the most significant concern of using different rooms is that of physical space due to differences in room size. Participants within the group study condition may have been affected by this disproportionately due to participating simultaneously with other individuals, which necessitated the need for more physical space than what the solo study condition needed for safe computer game play.

A limitation of the measures that were used was the absence of reverse-scored items; the items on both the SSQ6 and the SEEHS were positively phrased. Reverse-scoring is achieved by making alterations to the wording of an item, for example, by altering an item to read negatively instead of positively. The benefit of reverse-scoring is that it can be used to detect participant fatigue/boredom, acquiescence, and extreme response bias, thereby contributing to the validity of a measure. This is because it would be typically expected for a participant to respond to most items in a consistent direction, positively or negatively, and this would present on reverse-scored items towards the opposite side of the scoring scale. The SSQ6 is not suitable for reverse-scoring as items comprising the SSQN factor ask respondents to populate a list rather than indicate (dis)agreement, for example, on a reversible scale; however, other measures that do, such as the SEEHS, could have been altered to include reverse-scored items.

3.5.1.3. Analysis.

3.5.1.3.1. Data screening.

Before data analysis, a rigorous data screening process was carried out. This involved inspection of the data set using histograms, box plots, standardised residuals, and Cook's distance values. The data screening process was conducted using guidance from the statistical literature (Bollen & Jackman, 1990; Field, 2016, 2017) to flag potentially problematic cases, which were then investigated further. Outright removal of cases when data screening parameters are violated, such as Cook's distance values exceeding associated cut-off values or standardised residuals greater than 2.58 or 3.29 occurring unexpectedly frequently, is irresponsible as it is possible for an outlying or influential case to be a legitimate measurement. As such, consideration of deletion of cases from the data-set was done so on a case-by-case basis only after they had been flagged for further investigation. As part of the data-screening process one case was removed from the data set after being identified as a case of undue influence and statistical outlier and, from examining the case's data, a plausible explanation of unexpected life events supported the removal of this case.

The number of participants that were recruited for the present study ($N = 65$) was, initially, larger than indicated by prospective power analysis ($N = 63$, $n = 21$). However, due to the aforementioned removal of eight cases due to violations of inclusion/exclusion criteria and one case of a statistical outlier with undue influence on the data set data from $N = 56$ was retained for descriptive and inferential analysis. Using a smaller sample size than what prospective power analysis indicated is a limitation of the present study due to the associated

implications that this has on statistical power. A reduction in statistical power makes it more likely to not detect an effect where one has occurred (Type II error), also known as a false-negative. As such, it is possible in the cases of non-significant test results that an effect may have occurred, but the statistical tests that were used lacked the appropriate statistical power to detect it, due to the reduced sample size. The recruitment of a larger number of participants, in addition to the aforementioned consideration to review data when it is collected, would have been beneficial to provide the study's analysis with a more appropriate level of statistical power

The data-screening process involved an assessment of the data set to determine if the data set possessed the properties necessary to satisfy the parametric assumptions, which are necessary for parametric inferential analysis to be meaningful. The data set met the parametric assumptions of normal distribution of interval data and independence of scores. The assumption of homogeneity of variance was assessed using Levene's test in conjunction with variance ratios. When testing the vigorous-intensity physical activity outcome at initial and week eight measurements and the variance of the initial measurement of the total physical activity outcome the sample was found to be heterogeneous, across the experiment groups. As such, following the advice of Keppel (1991) the significance level for statistical testing was set at .025 rather than the typical .05 for vigorous-intensity physical activity in 3×2 mixed ANOVA and ANCOVA and total physical activity in 3×2 mixed ANOVA. The purpose was to account for the increase in probability of making Type I errors that variance heterogeneity can lead to. Lastly, homogeneity of regression slopes was satisfied for six of the seven outcome measures, SSQN being the violating outcome measurement. However, the impact

of non-homogeneity of regression slopes is mitigated by the findings of Glass et al. (1972), Harwell (2003), and Peckham (1968), who suggest that the effect of heterogeneous regression slopes is minimal, for example in instances where the number of participants between conditions are unequal, as is the case in the present study.

In summary, the data-screening process was rigorous and responsibly conducted, which yielded a data set that was suitable for parametric inferential analysis. The inferential analytical strategy used in the present study involved 3×2 mixed ANOVA, ANCOVA, and mediation analysis, which are discussed in this order in Section 3.5.1.3.3.

3.5.1.3.2. *Reliability analysis.*

The measures that were used within the study, the SSQ6 and the SEEHS, are both well-established within psychological literature and have been found to have between excellent ($\alpha \geq .9$) and good ($.8 \leq \alpha < .9$) internal reliabilities by the measure authors with values between $\alpha = .90$ and $.93$, and $\alpha = .83$ and $.85$, respectively (Sallis et al., 1988; Sarason et al., 1987). Internal reliability of these measures was assessed with the present study's data. The SSQN factor of the SSQ6 was found to have excellent ($\alpha \geq .9$) internal reliability and the SSQS factor had between good ($.8 \leq \alpha < .9$) and excellent ($\alpha \geq .9$) reliability. The SEEHS ranged from acceptable ($.7 \leq \alpha < .8$) to good ($.8 \leq \alpha < .9$) in internal reliability. However, the sample size used within the present study was insufficient to appropriately conduct factor analysis on the scales that were used. Despite this, as previously identified the SSQ6 and SEEHS are both widely used within

psychological research and have been previously assessed as being reliable constructs (Sallis et al., 1988; Sarason et al., 1987).

3.5.1.3.3. *Inferential analysis.*

The inferential techniques that were used were effective in testing the established hypotheses of the study, which is broken down on a test-by-test basis below. An effective use of supplemental techniques, MBIs, and Zhao et al.'s (2010) typology of mediations and non-mediations, supported the inferential analyses and provided additional credibility to the interpretation of findings.

Hypotheses H_{1a}-H_{1d} stated that group activity increases social support, self-efficacy, moderate-and/or vigorous- intensity physical activity, and the frequency of physical activity over time more so than solo activity. As such, this would involve testing for both an independent measure, group study condition against solo study condition, and a repeated measure, baseline against week eight. Therefore, a mixed ANOVA was an appropriate choice of inferential test for this purpose to test for an interaction effect between two independent groups across a repeated variable over time.

ANCOVA was used to test hypotheses H_{2a}-H_{2d}, which stated that computer game play would produce greater levels of social support, self-efficacy, or physical activity (moderate-intensity, vigorous-intensity, total, and the frequency of physical activity) when compared to no computer game play, but only if the computer game play is sociable. The benefit of using ANCOVA is that it facilitated the ability to observe the impact of the study's intervention on the final outcome variable measurements whilst controlling and thereby removing the influence of the initial outcome variable measurements. What this means is that it is likely that

initial scores of social support, for example, may influence the perception of social support at the end of the intervention; an individual perceiving a large amount of social support may be more likely to experience this eight weeks later regardless of participation within the intervention. Therefore, ANCOVA was an appropriate choice of inferential test to observe the efficacy of the study's intervention on the measured final outcome variables of social support, self-efficacy, and physical activity.

The performed 3×2 mixed ANOVA and ANCOVA were thorough and yielded valuable information regarding the efficacy of the intervention. However, these tests were supplemented by the inclusion of MBIs. As previously explained (Section 3.4.3.1.) there are a number of benefits to using MBIs alongside NHST.

The application of MBIs has provided further rich information on top of the information obtained through 3×2 mixed ANOVA and ANCOVA. An established benefit of MBIs is the avoidance of erroneous interpretations that strict reliance on p may lead to; either an effect is important or it is not important determined by whether p is $> .05$ or $< .05$. The use of probabilities to produce meaningful qualitative statements adds further strength to the analysis due to the avoidance of definitive statements, thereby negating the potential for Type I and Type II errors to occur. Lastly, the generation of clinical inferences provides value for real-world applicability of the intervention where a more stringent acceptance of potential harm is taken.

Mediation analysis was performed within the present study in order to test the proposed model of mediation as stated in hypothesis H₃. The procedure that was used to conduct mediation analysis was informed through literature such as Field (2017), Hayes (2018), and MacKinnon (2008), and consequently involved modern

techniques. The interpretation of mediation analysis was supplemented using Zhao et al.'s (2010) typology of mediations and non-mediations, which was effective in establishing the parameters in which mediation can be said to have occurred or, alternatively, not to have occurred.

3.5.2. Discussion of findings.

This section discusses the findings of the study. This includes a summary of the inferential analyses findings, as well as applying them to the wider psychological literature. A statement of Study 1's unique contribution(s) to knowledge is also made.

3.5.2.1. Summary.

3.5.2.1.1. 3×2 Mixed ANOVA.

Mixed ANOVA was used to determine if social support (H_{1a}), self-efficacy (H_{1b}), moderate- and/or vigorous-intensity physical activity (H_{1c}), and frequency of physical activity (H_{1d}) increased in the group study condition over time more so than the solo study condition.

No significant differences were detected between the group and solo study conditions with any of the study's outcome measures as dependent variables. As such, the findings are inconsistent with the predictions made by H_{1a-c} , leading to their rejection. However, a significant interaction involving the frequency of physical activity was identified within the predicated direction, which is consistent with the prediction made by H_{1d} , leading to its acceptance.

Despite the non-significance of the simple contrasts, the performed MBIs did reveal four instances of positive mechanistic inference and three instances of

clinical inference in which the intervention was recommended for use. Likely positive inferences were made with SSQS, vigorous-intensity physical activity, and total physical activity as the dependent variable, and a likely positive inference was made with frequency of physical activity as the dependent variable. The intervention was inferred to be likely beneficial and very unlikely to be harmful for the dependent variables SSQS, vigorous-intensity physical activity, and total physical activity and was recommended for use. As such, the instances in which the intervention was inferred to be positive, beneficial, and recommended for clinical use when comparing the group study condition with the solo study condition provide evidence to support that exposure to sociable computer game play yields a favourable effect on satisfaction with social support and physical activity outcomes despite the non-significance of associated NHSTs.

However, MBI analysis returned unclear inferences with SSQN, SEEHS, and moderate-intensity physical activity as dependent variables when comparing the group and solo study conditions; additional data would be needed to make clear inferences. As Hopkins et al. (2009), van Schaik and Weston (2016), and Weston et al. (2014) indicate, unclear inferences can be given qualitative descriptors, based on the upper and lower ends of the confidence interval, to define the likely range of the effect; see Table 3.30, which presents the unclear inferences from 3×2 mixed ANOVA with associated qualitative descriptors. Qualitative descriptors are informed by Hopkins' (2002) scale of magnitudes for effect statistics, which associates appropriate descriptors to specific ranges of values. The following descriptors are associated with specific ranges of values from odds ratio, trivial (± 1 to ± 1.5), small (± 1.5 to ± 3.5), moderate (± 3.5 to ± 9), large (± 9 to ± 32), very large (± 32 to ± 360), nearly perfect ($> \pm 360$), and perfect (infinite).

Table 3.30

Unclear inferences from 3×2 mixed ANOVA including the value of effect statistic, ±90% confidence limit, lower, and upper limits with associated mechanistic inference qualitative descriptors.

Outcome	Value of effect statistic (mean difference)	±90% CL	Likely range of the effect		Qualitative description
			Lower limit	Upper limit	
SSQN	0.80	1.23	-0.43	2.03	At most a small positive or a below trivial negative effect.
SEEHS	-0.01	0.38	-0.39	0.38	At most a below trivial positive or a below trivial negative effect.
Mod PA	16.42	32.45	-16.03	48.87	At most a very large positive or a large negative effect.

Note. SSQN = Social Support Questionnaire number score; SEEHS = Self-Efficacy and Exercise Habits Survey; Mod = moderate-intensity; PA = physical activity; CL = confidence limit; to calculate the likely range of the effect deduct ±90% CL from value of effect statistic for lower limit and sum for upper limit; dividers between inferences included for clarity.

Given the associated qualitative descriptors for the three unclear inferences from 3×2 mixed ANOVA it can be seen that the true effect would be more likely to be in the realm of the intervention being positive for SSQN and moderate-intensity physical activity; however, the associated chance of a negative outcome is less likely but, too large for these two instances to be recommended for use. In the case of the SEEHS inference, the range of the true effect is too small to be noteworthy and therefore trivial.

3.5.2.1.2. ANCOVA.

Whilst initial outcome scores (the covariates) were held constant, ANCOVA was used to determine if sociable computer game play in particular, rather than computer game play in general, facilitated greater levels of social support (H_{2a}), self-efficacy (H_{2b}), moderate- and/or vigorous-intensity physical activity (H_{2c}), and frequency of physical activity (H_{2d}). As such, this necessitated the comparison of the group study condition with the solo study condition as well as comparison between the solo and control study conditions.

ANCOVA revealed that each covariate (initial measurement) significantly influenced their associated week eight outcome variable. Otherwise, all experimental effects were non-significant apart from that between the group and solo study conditions when frequency of physical activity was the dependent variable. This suggested that the group study condition engaged in physical activity more frequently than the solo study condition, consistent with H_{2d} . Otherwise, the findings are inconsistent with the predictions made by H_{2a-c} in regards to the effect of sociable computer game play. However, despite rejecting hypotheses H_{2a-c} , findings were consistent with the predicted effect of non-sociable

computer game play when compared to the control study condition. Specifically, it was found that non-sociable computer game play had no difference in social support, self-efficacy, or physical activity when compared to the control study condition.

MBI inferred two noteworthy mechanistic inferences involving the SSQS and SEEHS dependent variables when comparing the solo and control study conditions. The inference with SSQS as the dependent variable was considered to be possibly negative with the associated clinical inference recommended against use because it was considered to be possibly harmful. The inference with SEEHS as the dependent variable was considered to be likely positive with the associated clinical inference recommended use because it was considered to be beneficial. These inferences provide some evidence to suggest that small differences between the solo and control study conditions may have occurred despite the findings of the associated ANCOVA testing between the solo and control study conditions.

MBI inferred four likely positive mechanistic inferences involving the SSQN, vigorous-intensity physical activity, total physical activity, and frequency of physical activity outcomes when comparing the group and solo study conditions. In each of these instances their associated clinical inferences recommended use of the intervention as well. A most likely trivial mechanistic inference was made with SEEHS as the dependent variable; in this instance, clinical inference recommended against use of the intervention. The inferences in which the intervention was inferred to be mechanistically positive and clinically beneficial when comparing the group study condition with the solo study condition provide evidence, despite the non-significance of the associated NHSTs, to support the

idea that exposure to sociable computer game play beneficially affects the quantity of social support received and physical activity outcomes.

MBI inferred two unclear mechanistic inferences involving the SSQS and moderate-intensity physical activity outcomes when comparing the group and solo study conditions. MBI inferred five unclear mechanistic inferences with the SSQN, moderate-intensity physical activity, vigorous-intensity physical activity, total physical activity, and the frequency of physical activity outcomes when comparing the solo and control study conditions. Table 3.31 presents each of these unclear inferences with associated qualitative descriptors, as appropriate, to define the likely range of each effect (Hopkins, 2002; Hopkins et al., 2009; van Schaik & Weston, 2016; Weston et al., 2014).

Table 3.31

Unclear inferences from ANCOVA including the value of effect statistic, $\pm 90\%$ confidence limit, lower and upper limits with associated mechanistic inference qualitative descriptors.

Outcome	Comparison	Value of effect statistic (mean difference)	$\pm 90\%$ CL	Likely range of the effect		Qualitative description
				Lower limit	Upper limit	
SSQN	Solo vs control	-0.57	49.18	-49.76	48.61	At most a very large positive or a very large negative effect.
SSQS	Group vs solo	0.46	1.28	-0.82	1.75	At most a small positive or a below trivial negative effect.
Mod PA	Group vs solo	16.42	218.21	-201.79	234.63	At most a very large positive or a very large negative effect.
	solo vs control	-23.61	41.54	-65.15	17.93	At most a large positive or a very large negative effect.
Vig PA	Solo vs control	-2.28	91.03	-93.31	88.75	At most a very large positive or a very large negative effect.
Total PA	Solo vs control	-25.89	60.96	-86.85	35.07	At most a very large positive or a very large negative effect.
PA freq.	Solo vs control	0.23	0.69	-0.46	0.92	At most a below trivial positive or a below trivial negative effect.

Note. SSQN = Social Support Questionnaire number score; SSQS = Social Support Questionnaire satisfaction Score; Mod = moderate-intensity; Vig = vigorous-intensity; PA = physical activity; freq. = frequency; CL = confidence limit; to calculate the likely range of the effect deduct $\pm 90\%$ CL from value of effect statistic for lower limit and sum for upper limit; dividers between inferences included for clarity.

The associated qualitative descriptors of the seven unclear inferences from ANCOVA do not indicate any instances where the true effect is substantially more likely to be positive than negative, unlike was the case for the 3×2 mixed ANOVA unclear inferences. Five of the inferences which compared the solo and control study conditions indicated that the range of the true effect was equally likely to be positive or negative and, as such, there is no discernible direction to suggest whether the intervention was positive or negative; the inferences where this was the case were for SSQN, moderate-intensity (solo vs control), vigorous-intensity, and total physical activity as well as the frequency of physical activity. These inferences suggest that the effect of the intervention was no different for the solo and control study conditions. This supports the conclusions made from ANCOVA and associated partial evidence of the predictions made by hypotheses H_{2a-d}. The unclear inference involving SSQN when comparing the group and solo study conditions provides some directional information suggesting that the range of the true effect was more likely to be positive than negative, which is supportive of predictions; however, the chance of a negative outcome is unacceptably high for the intervention to be considered effective in this case. The unclear inference involving moderate-intensity physical activity when comparing the solo and control study conditions revealed that the range of the true effect was more likely to be negative than positive, which is counter to predictions.

3.5.2.1.3. Mediation analysis.

Mediation analysis was performed to determine if physical activity was influenced by social support and mediated by self-efficacy (H₃). Using Zhao et al.'s (2010) typology of mediations and non-mediations to evaluate each mediation analysis,

three instances of indirect-only mediation were identified in the group study condition with the SSQS factor of the SSQ6 as the predictor and moderate-intensity, vigorous-intensity, and total physical activity as outcomes. Indirect-only mediation occurs when the indirect effect pathway has been established but the direct effect has not. This finding suggests that mediation occurred and provides evidence for H₃. All other mediation analyses were evaluated as having no-effect mediation, suggesting that mediation did not occur in those instances.

3.5.2.2. Application of findings to literature.

The present investigation aimed to utilise sociable computer game play to facilitate physical activity in participants. A thorough discussion and application of Study 1's findings to the theoretical framework is presented within the general discussion (Chapter 6).

Through NHST it was found that participants within the solo and control study conditions did not differ in social support, self-efficacy, or physical activity, consistent with H_{2a-d}. However, in Staiano and Calvert's (2011) investigation it was found that participants engaging in single-player computer game play against computer-generated opponents differed from the control group. In this study calorific expenditure was the outcome measurement. This explains why a difference was found as the control group was sedentary whereas the single-player computer game condition engaged in exergame play. This might suggest that a calorific expenditure difference between the solo and control study conditions may have occurred in the present study, simply due to the nature of the study requiring the solo study condition to play Wii Sports, an exergame, and the control study condition to do nothing. However, social support, self-efficacy, and

quantity/frequency of physical activity did not differ between the solo and control study conditions provides evidence that computer game play alone is insufficient for facilitating physical activity-related behaviour change. The MBI comparison involving the self-efficacy outcome measurement, and the solo, and control study conditions identified a likely positive effect of the solo study condition, which clinical inference recommended use. This MBI comparison provides some evidence of a difference between the solo and control study conditions despite a non-significant outcome from the associated ANCOVA.

A number of investigations identified the importance of social support in facilitating physical activity (Beets et al., 2010; Belanger & Patrick, 2018; da Silva et al., 2013; Eather et al., 2013; Mendonça & de Farias, 2015; Morrissey et al., 2015; Quaresma et al., 2014) as well as the role that self-efficacy may take in this relationship (Cheng et al., 2014; de Lacy-Vawdon et al., 2018; Fernández et al., 2014). This, in addition to the literature included within the thesis literature review, led to the hypotheses in the present study that sociable computer game play would facilitate social support, self-efficacy, and physical activity. The NHST findings of Study 1 do not support these hypotheses as no statistically significant differences between the group and solo study conditions were identified, indicating that sociable computer game play was ineffective at influencing the measured psycho-social outcomes. However, a number of the performed MBIs did infer positive (likely and possibly) effects that the group study condition had when compared to the solo study condition. In these comparisons clinical inference recommended the group study condition for use, supporting the findings of the previously mentioned psychological literature. Specifically, clinical inference

recommended the sociable-computer game play intervention for use for the SSQS, vigorous-intensity, and total physical activity outcome measurements.

The performed MBIs that identified positive effects of the group study condition when it was compared to the solo study condition are important and noteworthy as these findings are corroborative of the above identified literature that associates social support with physical activity. Specifically, the findings suggest that perceived satisfaction with available social support is positively influenced by sociable computer game play, whereas, sociable computer game play did not appear to influence the quantity of social support. Much of the reviewed literature identified that different sources of social support, such as friends or family, provide varying forms of social support to an individual and also vary in their efficacy to modify behaviour. For example, Belanger and Patrick (2018) found that social support from friends exerted a stronger effect upon college student's physical activity behaviour than family social support did; furthermore, friends provided higher levels of tangible social support through companionship, whereas family provided higher levels of intangible sociable support through esteem and informational support. The finding that social support from friends is more predictive of physical activity behaviours was also found by da Silva et al. (2013) and Mendonça and de Farias (2015) in samples of Brazilian adults and Brazilian adolescents, respectively. As such, it is conceivable to consider that certain forms of social support, such as tangible or intangible social support, are more preferable to an individual and therefore, when made available, satisfaction with received social support may increase.

The inferences which indicated a positive/beneficial effect of the intervention on social support (SSQS) as well as physical activity (vigorous-intensity and total)

when comparing the group and solo study conditions provide support for the social cognitive theory outlined previously (Section 3.2.2.). This posits that behaviour change may occur as a product of tangible and intangible forms of social support given through encouragement and/or observation (Beets et al., 2010; Edwardson et al., 2013). Previously described intervention-based investigations have identified the importance of social support in facilitating successful physical activity-related behaviour change (Fernández et al., 2014; Eather et al., 2013; Quaresma et al., 2014), which are congruent with the positive/beneficial MBI results of the present investigation.

The indirect-only mediating effects that were identified following mediation analysis in the group study condition with SSQS as the predictor and moderate-intensity, vigorous-intensity, and total physical activity as outcomes provide evidence to suggest that mediation occurred, as hypothesised (initially depicted in Figure 3.1.): self-efficacy mediated the relationship between SSQS and the physical activity outcomes. The relationship between social support and physical activity, in which, self-efficacy acts as a mediator was identified in previous intervention-based research (Eather et al., 2013; Mendonça, & de Farias, 2015; Peterson et al., 2008; Quaresma, 2014). This suggests that social support and self-efficacy are both important factors in exercise-related behaviour change, a notion further supported by the findings of the present investigation.

3.5.3. Study 1's unique contribution to knowledge.

In conclusion, Study 1 has contributed meaningfully to psychological knowledge in a number of ways as highlighted within this section. Firstly, regarding the design of the conducted experiment involving three study conditions, group, solo, and control, typically studies within the literature, such as Staiano and Calvert (2011), have used treatment-and-control group designs, in which the experimental effect is tested by comparison to a non-treated control group and any changes in dependent variables are then attributed to the effect of the treatment. However, within the present study such a design would make it difficult to infer whether or not computer game play or sociable computer game play were attributable for changes in dependent variable measurements. As such, the inclusion of the solo study condition has facilitated the ability to measure the treatment effect of computer game play against sociable computer game play, through the group study condition, while, in addition, maintaining the scientific rigour that is provided by the inclusion of a control group.

Some of the analytical methods that were employed within the present study, although not unique, are not widely used within the psychological literature; this is especially true in the case of MBI. The present study has contributed to the field of health psychology by uniquely including MBI within the analysis as well as justifying the use of this technique, in addition to identifying the associated shortcomings of sole-reliance upon NHST techniques (Batterham & Hopkins, 2005; Cumming, 2014). This practice will help progressive analytical techniques, such as MBIs, to gain further exposure as effective techniques that provide more informative and rich inferences that NHST alone cannot and, consequently, may aid in more widespread adoption of these techniques by other researchers.

Specifically within the present study, the supplementation of MBI using planned comparisons from both 3×2 mixed ANOVA and ANCOVA identified numerous important effects that would not have been detected due to non-significance from NHST analysis. Following 3×2 mixed ANOVA, MBI inferred the group study condition to be mechanistically likely positive and clinically likely beneficial when compared to the solo study condition for the SSQS, vigorous-intensity physical activity, and total physical activity outcomes. Following ANCOVA, MBI inferred the group study condition to be mechanistically likely positive and clinically likely beneficial when compared to the solo study condition for the SSQN, vigorous-intensity physical activity, total physical activity, and frequency of physical activity outcomes. The significance test (ANCOVA) comparing the group and solo study conditions for the frequency of physical activity was significant, the other tests of significance associated with these inferences were statistically non-significant and as such, without MBI it would be concluded that the group and solo study conditions differed only in frequency of physical activity.

The findings of Study 1 are original and can make a unique contribution to the field of health psychology. Firstly, this is due to the aforementioned use of group, solo, and control study conditions which has provided the opportunity to establish evidence that sociable computer game play can be an effective technique to facilitate exercise-related behaviour change, while demonstrating that solitary computer game play in general is not capable of achieving this outcome.

Additionally, the application of Iwasaki and Mannell's (2010) hierarchical model of leisure stress coping within the present study is unique in its use as a theoretical basis for the study to justify why sociable computer game play may be facilitative of social support. The application of Iwasaki and Mannell's (2010) hierarchical

model of leisure stress coping supported the initial pathway which predicts an increase in social support within the proposed mediating model (Figure 2.12. and Figure 3.1.) This unique application of the model was successful due to the identification of indirect-only mediation occurring with satisfaction with social support (SSQS) as the predictor and the moderate- and vigorous-intensity physical activity, and total physical activity outcomes. This provides original evidence to support the postulation that social support, which has been derived from sociable computer game play, can be effective in facilitating physical activity-related behaviour change through a relationship that is mediated by self-efficacy. Further discussion of the original use of Iwasaki and Mannell's (2010) hierarchical model of leisure stress coping in relation to the present study is presented in the general discussion (Chapter 6).

3.5.4. Modifications to be made for subsequent investigation.

In evaluating the strengths and limitations of Study 1 in terms of the design, method, and analytical techniques that were used, a number of opportunities for improvement have been identified that can be implemented into subsequent investigation(s). As such, this section outlines the various changes that were made to the design and method of the subsequent study (Study 2) that is presented within this thesis (Chapter 4).

Following the data screening process, detailed in Section 3.4.2., a number of cases were identified for removal from the data set for violating the limits of the study's inclusion criteria as well as other cases removed from the data set due to insufficient participation in the intervention. As such, any instances in which erroneous or impossible values were recorded or inclusion criteria were violated

were not detected until data collection for the study had concluded and data screening procedures were initiated. Therefore, the data collection process to be conducted during Study 2 involved cursory checks of collected data at each measurement point to ensure that any anomalous findings were detected as soon as possible. This was not used or meant as a data-screening process for the detection of outliers, which would be inappropriate. Instead, this procedure was deployed in an attempt to identify erroneous data entries such as items that were not responded to or impossible values entered, for example, which participants can then be alerted to and corrected immediately.

As described within the method (Section 3.5.1.2.) a number of rooms were used during the course of data collection during the study, which potentially may have led to the introduction of confounding variables due to differing environmental stimuli such as ambient temperature, light level and quality (artificial vs natural), and space available for engaging with the computer game Wii Sports. This was addressed within Study 2 where the experiment was conducted in a consistent environment at each measurement point and between all participants. As such, securing a room for consistent usage helped to mitigate the described potential confounding environmental effects that may have occurred within the present investigation due to the usage of different experimental spaces.

The group study condition initially stipulated that each 'team' of participants must consist of four participants; this was later iterated on and modified to allow for the recruitment and participation of 'teams' with between two-to-four participants. This change expedited participant recruitment for the group study condition and consequently the collection of data which had been troublesome before the implementation of this change. As such, it was decided that Study 2 would use

similar methods for the recruitment of participants into the group study condition in order to ensure a satisfactory data-set was collected within an acceptable period of time.

As previously identified (Section 3.5.1.2.), the measures used in Study 1 did not include any reverse-scored items, reverse-scoring can contribute to a measure's validity by providing opportunities to detect participant fatigue, acquiescence, and extreme response bias. As such, the measures that were used within Study 2, where it is possible to do so, had reverse-scored items implemented. It was expected that this would not negatively affect the analytical procedures that Study 2's data set would be subjected to. This is because analysis software such as SPSS can be programmed to automate and account for reverse-scored items, thereby minimising any potential error from the researcher.

Chapter 4 - Study 2

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4.1. Abstract - Study 2

Sociable computer game play was investigated for its capacity to be facilitative of reducing perceived stress by way of a mediation relationship predicted by social support and mediated by self-efficacy. The study design involved a group study condition requiring sociable computer game play, a solo study condition requiring solo computer game play, and a control study condition with no computer game play. A self-selected sampling strategy was used to recruit $N = 83$ (73.03% female; mean age = 25.40) allocated, quasi-randomly, in teams of two-to-four to the group study condition, or randomly to the solo or control study conditions. Computer game play (Wii Sports) occurred for 30 minute periods on a weekly basis for eight weeks with measurements of social support (quantity of and satisfaction with), generalised self-efficacy, and perceived stress being taken following computer game play.

Analysis involved three-by-two (study condition by time point) mixed ANOVA and ANCOVA, which were supplemented with MBI, and mediation analysis. Mixed ANOVA revealed that the group study condition significantly lowered in social support (quantity) during the intervention when compared to the solo study condition. In this comparison mechanistic inference indicated the intervention to be likely negative, which was not expected. MBI indicated that the group study condition was not clinically beneficial for any of the outcome measures. ANCOVA revealed that at the end of the intervention the solo and control study conditions did not differ in social support (satisfaction), general self-efficacy, or perceived stress but, did differ significantly in social support (quantity) indicating it to be higher in the solo study condition. ANCOVA revealed that following the intervention the solo study conditions had significantly higher social support

(quantity) than the group study condition, no other significant effects were detected. MBI clinical inference indicated the group study condition to be beneficial for social support (satisfaction) when compared with the solo study condition. The solo study condition was clinically inferred to be beneficial for social support (quantity) when compared to the control study condition. Mediation analysis revealed three instances of indirect-only mediation, which were detected within the group study condition with social support (satisfaction) as the predictor and within the solo study condition with social support (quantity and satisfaction) as predictors.

Following mixed ANOVA and ANCOVA, findings suggest that sociable computer game play was not facilitative of social support (quantity), self-efficacy, or reduced perceived stress. When comparing the group and solo study conditions findings indicate that sociable computer game play was clinically beneficial for satisfaction with social support. Mediation analysis suggests that social support, general self-efficacy, and perceived stress are associated in a mediation relationship, which is predicted by social support and mediated by general self-efficacy.

The application of Iwasaki and Mannell's hierarchical model of leisure stress coping is novel in theoretically establishing computer game play as a sociable activity and thereby facilitative of social support. This led to the unique arrangement of social support, self-efficacy, and perceived stress in a mediation model. Elements of the research design involving three study conditions provided the opportunity to establish sociable computer game play or game play in general as being facilitative of positive health-related behaviour. The use of MBI is unique within this area of health psychology and provided useful rich information beyond that typical of mixed ANOVA and ANCOVA.

4.2. Introduction - Study 2

4.2.1. Background.

The perception of psychological stress is considered to occur when an individual perceives that the demands made by their environment tax and/or exceed their personal adaptive capacity (Cohen, Kessler, & Gordon, 1995). The physiology of the stress response is well understood in scientific literature and involves the hypothalamic-pituitary-adrenocortical axis (HPA) and the sympathetic-adrenal-medullary (SAM) systems which co-ordinate an array of metabolic and physiological changes in the body. Activation of the HPA and SAM systems is done so in order to maintain homeostatic balance within the body, in other words, in order to balance the physiological impact of increasingly severe stressors, homeostatic resources are increased to meet the demands and thereby maintain balance (Lovullo, 2016). Allostasis is the term coined by McEwen and Stellar (1993) to describe the cumulative physiological strain that maintenance of homeostatic regulation costs in compensatory resources during prolonged stressor exposure.

Frequent or prolonged activation of the HPA and SAM systems can interfere with their control of other physiological systems which can result in increased risk for physical and psychological disorders (McEwen, 1998). Allostatic loads can therefore be deleterious to health because physiological resources are already being directed to maintain homeostatic balance. This continual demand competing for coping resources reduces the ability of an individual to cope psychologically or physiologically with new demands that may present themselves, perhaps as new stressors (McEwen, 2000). There is evidence suggesting that the immune system,

for example, is one such system that can become compromised when resources are scarce due to allostatic load which can lead to a heightened susceptibility to infection (Brunner & Marmot, 2006).

The described increased risks for physical and psychological disorders presents as a broad range of associated disease and negative health outcomes, which include deleterious effects upon mental health such as depression, anxiety, and insomnia (Rizer, Fagan, Kilmon, & Rath, 2016) and physiological health such as heart disease, autoimmune disorders, diabetes, and obesity (Rizer et al., 2016; Segerstrom & O'Connor, 2012). Other diseases are affected by psychological stress, often resulting in a more rapid onset of illness such as HIV progressing to AIDS or the growth and metastasis of cancerous tumours (Cohen, Janicki-Deverts, & Miller, 2007). Gastric ulcers are associated with psychological stress and occur similarly to the dampening of the immune system where the allostatic response may divert essential resources away from the digestive tract (Brunner & Marmot, 2006). Psychological stress has been found to facilitate the uptake of negative health behaviours such as smoking and excessive alcohol intake as well as the adoption of predominantly sedentary life-styles as a means of attempted coping (Krueger & Chang, 2008).

This association between psychological stress and illness is costly to both healthcare, business, and consequently, the economy. HSE (2018) reported that work-related stress, a harmful reaction individuals have to undue pressures and demands in the workplace, was responsible for 44% of work-related ill health and 57% of working days lost in 2017/2018, the most cited causes of work-related stress being workload, lack of managerial support, and organisational change. Furthermore, the HSE (2016) reported that work-related stress costs

approximately £5.2 billion per year to UK society as a whole, including costs to the individual, employers, and government.

The effect of psychological stress on individuals has been found to be influenced by external factors for example poverty. Krueger and Chang (2008) found in a study involving a representative U.S. sample ($N = 40,335$) that among those of low socioeconomic status the impact of psychological stress on mortality was larger than those of middle or high socioeconomic standing. The effect of quality of sleep on psychological stress has been given recent attention; McEwen (2006) proposed that sleep deprivation can be considered to be an additional contributor to allostatic load. Supporting this, Benham (2010), observed that poor sleep quality might influence the association between stress and health, as it was found that an increase in the predictive power of a stress-health model when including sleep data. However, it is acknowledged that a substantial amount of unexplained variance in health yet remains. Despite promising research including a diverse range of populations (students, full-time workers, and psychiatric outpatients) studying the sleep-stress-health relationship, Mullan (2014) commented that there is, however, further need for intervention-based research designed to improve sleep to be conducted.

Social support has been observed to affect the stress-health relationship.

Schwarzer, Jerusalem, and Hahn (1994) conducted a longitudinal study involving 235 migrants moving from East to West Germany after the fall of the Berlin wall.

They were measured at three distinct points in time, which included autumn and winter of 1989/1990, summer 1990, and summer 1991 where employment status, received and perceived social support, and health complaints were measured.

Analysis revealed that of those who did not find employment had poorer self-

reported health. However, the stress-health relationship was moderated by social support in that those who were unemployed but reported having social support were less likely to report ill-health. Social support acted as a buffer against stress and ill-health in those who remained unemployed long-term (from the beginning of the study).

Segrin and Passalacqua (2010) found a significant association between loneliness (an absence of social support) and poor health, this relationship was mediated by health behaviour such as poor sleep. The authors identified that perceived stress following loneliness and other problematic health behaviour such as inadequate sleep further impacted the loneliness-health relationship. Their findings corroborate with Hawkley and Cacioppo's (2007) who presented a range of evidence associating loneliness with directly deleterious effects on health.

Hawkley and Cacioppo (2007) base this association on five distinct mechanisms; firstly, that of health-associated behaviours, loneliness is more associated with increased BMI, overweight/obesity, physical inactivity, and smoking (Lauder, Mummery, Jones, & Caperchione, 2006). Secondly, the increased exposure to stressful life events, as loneliness is associated with greater recollection of childhood stressful life events and the present-day negative effects of those events as well as a larger frequency of chronic stressors such as financial, work, and general difficulties (Hawkley & Cacioppo, 2007; Hawkley, et al., 2008). Thirdly, exposure to perceived stress and coping responses, as lonely individuals are more likely to report feelings of helplessness, activities as being more stressful, and themselves as being less capable of meeting the challenges of daily activities than non-lonely individuals (Hawkley, Burleson, Berntson, & Cacioppo, 2003; Hawkley et al., 2008). Fourthly, the response to stress, where loneliness is inversely

associated with active coping such as seeking emotional or instrumental support and is associated with behavioural withdrawal, a coping style that typically perpetuates stress rather than alleviates it (Cacioppo, et al., 2000; Hawkley et al., 2008). Lastly, recuperative processes following stress, loneliness associated with poorer sleep (increased frequency of micro-awakenings) as well as longer sleep latency and greater daytime dysfunction (Cacioppo et al., 2002).

As such, Hawkley and Cacioppo's (2007) research places substantial emphasis on the importance of social support in the stress-health relationship; where an individual perceives themselves to have social support, the perception of, reaction to, as well as the impact of stressors upon physiological and psychological health is reduced. Conversely, in instances where an individual is lonely due to a perception of no or little social support then stress becomes a greater threat to health.

Further research supporting the role of social support in the stress-health relationship can be seen in Segrin and Passalacqua (2010) who investigated potential explanations for the associations between social support, loneliness, stress, and health outcomes. As expected, it was found that loneliness was associated with lower social support and that loneliness significantly mediated the association between social support and health, as social support decreased loneliness increased and as loneliness increased, general health decreased. This mediating relationship was found in all instances which involved social support from different sources as predictors; significant other, friends, and family. It was established that the association between loneliness and reduced general health was mediated by perceived stress, which as Hawkley and Cacioppo (2007) indicate, lonely individuals have a tendency to regard life events as more stressful

and insurmountable than individuals who are less lonely. The quality of social relations was identified to be of importance for social support; the number of close friends and/or family was found to be more important than the sheer quantity of relations. Segrin and Passalacqua (2010) do, however, comment that it is difficult to establish causality in their study, stating that it is unclear if an absence of social support led to loneliness, stress and, in-turn, poor health, or, alternatively, if poor health led to stress and, in turn, loneliness.

The involvement of social support in the stress-health relationship has been investigated in a range of specific populations as well, for example with Japanese university students (Jou & Fukada, 2002). They found that social support reciprocity, social support that is provided to others balanced by social support received from others, promoted health in participants experiencing high levels of stress and that students become less healthy when receiving insufficient social support as well as when providing insufficient social support to others. Female migrant domestic workers in Singapore were investigated by Anjara, Nellums, Bonetto, and van Bortel (2017). They found that social support was inversely associated to stress, health, and quality of life, with participants reporting feeling stressed being more likely to be isolated. Conversely, very socially connected participants showed the highest quality-of-life scores. In U.S. hospitalised heart-disease patients, perceived social support was found to moderate the effect of post-discharge stress. An increase in post-discharge stress significantly increased 30-day since discharge depressive symptoms in patients with low social support (León-Pérez, Wallston, Goggins, Poppendeck, & Kripalani, 2016).

4.2.2. Reducing perceived stress through leisure.

There is a broad range of psychological literature regarding intervention-based strategies designed to reduce perceived stress in a variety of participant populations using various methods. Leisure has been found to have a noteworthy effect upon perceptions of and reactions to stress, such as Iwasaki and Mannell's (2000) hierarchical model of leisure stress coping that was described in Chapter 2. Bedini, Labban, Gladwell, and Dudley (2017) investigated the effects of leisure on stress and general health in individuals providing care to family members. It was found that each of the three measured leisure variables (leisure participation, satisfaction with time for leisure, and satisfaction with quality of the leisure experience) was positively associated with self-reported general health. More specifically, however, satisfaction with the time for leisure and satisfaction with quality of the leisure experience were more strongly associated to the reduction of perceptions of stress and therefore better self-reports of health than simply participation in leisure. As such, the authors conclude that for leisure to provide therapeutic benefits to perceptions of stress and health it needs to be meaningful to the individual. Bedini et al.'s (2017) findings are corroborative with earlier work such as leisure time being an important mechanism for buffering caregivers against stress (Losada et al., 2010) and leisure time reducing negative affect after daily stressful events (Qian, Yarnal, & Almeida, 2013).

As described, social support is strongly associated with the stress-health relationship (Anjara et al., 2017; Cacioppo et al., 2002; Hawkey & Cacioppo's, 2007; Hawkey, et al., 2008; Jou & Fukada, 2002; Lauder et al., 2006; León-Pérez, et al., 2016; Schwarzer et al., 1994; Segrin & Passalacqua, 2010), leisure is a

highly social activity to engage in and is integral in the development of friendships between individuals, which, in turn, facilitate the provision and receiving of social support between individuals (Coleman & Iso-Ahola, 1993; Schneider & Iwasaki, 2003). This view is supported by the leisure friendships sub-dimension of Iwasaki and Mannell's (2000) hierarchical model of leisure stress coping which describes the differing functional aspects of social support that an individual may believe themselves to receive from leisure involvement.

Pressman et al. (2009) found that individuals who engage in multiple enjoyable activities (leisure) were more likely to have lower blood pressure, cortisol levels, waist circumference, body mass index, and to have perceptions of better physical function. Of particular interest is the reduced cortisol level, suggesting that activation of the stress response is occurring less frequently or for shorter periods of time as cortisol is used to regulate the stress response (Lovallo, 2016).

Furthermore, of those who engaged in enjoyable activities more frequently were found to report greater levels of social support as well as improved life satisfaction and life engagement. In a qualitative study involving marginalised groups such as aboriginal individuals with diabetes, individuals with disabilities, and homosexuals, Iwasaki, Mackay, Mactavish, Ristock, and Bartlett (2006) found that leisure activity acted as a coping resource against the deleterious effects of stress and that the receiving of social support from others within the participant's communities was a significant part of the stress coping process of leisure engagement.

Computer games as a medium of entertainment and therefore a leisure pursuit provide unique opportunities to engage in sociable leisure with other individuals that is not necessarily constrained by geographic location, spoken language, or time zones. As described in Chapter 2, many studies have found that individuals

typically report that the desire to engage in sociable computer game play with others is a fundamental motivation for computer game play (Cole & Griffiths, 2007; Jansz & Tanis, 2007; Longman et al., 2009; Park et al., 2011; Reinecke, 2009b; Westwood & Griffiths, 2010; Williams et al., 2006; Williams et al., 2008; Yee, 2006a, 2006b). As such, further investigating the potential therapeutic effect that sociable computer game play may have in reducing perceived stress as well as developing further understanding on the precise mechanism of this interaction would be valuable.

4.2.3. The present investigation

The present study uses sociable computer game play as a stimulus to facilitate social support in participants. Similar to its use in Study 1, the computer game Nintendo Wii Sports was used as the sociable computer game due to its extensive use within the psychological literature and opportunities for self-determination (see Section 3.2.3. for more information). It was expected that if an increase in social support was successfully facilitated this would then facilitate an increase of self-efficacy within participants. It is then expected that such an increase in self-efficacy would provide the perceived capacity and confidence to modify behaviour to engage in stress-coping behaviours leading to a reduction in perceived stress. The postulation and supporting evidence that sociable computer game play can facilitate social support in individuals and in turn, that social support can contribute to an increase in self-efficacy is presented within the thesis introduction and literature review (Chapters 1 and 2). As such, a relationship between social support (predictor) and reduced perceived stress (outcome), which is mediated by self-efficacy is proposed (Figure 4.1.).

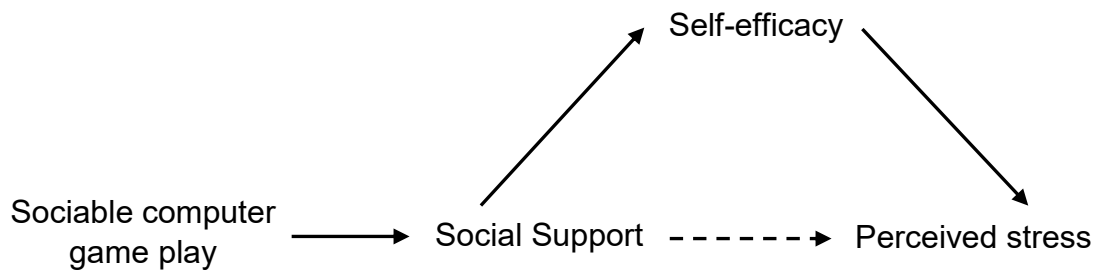


Figure 4.1. Proposed mediation relationship between social support (derived from sociable computer game play) and physical activity, with self-efficacy mediating the relationship.

If it can be established that sociable computer game play as a leisure activity can be facilitative of social support and in turn self-efficacy and reduced perceived stress, potentially through the proposed mediation relationship, then this would have practical real-world applications. This is because computer games are widely owned already and are typically affordable making them widely accessible to the public (Section 2.3.3.) and, as such, they could be used to bolster the social support, self-efficacy, and reduce perceived stress of players.

As such, the study aimed to demonstrate that sociable computer game play facilitates measurable improvements to social support, self-efficacy, and perceived stress. A second aim of the study was to establish that it is specifically sociable computer game play, not simply computer game exposure, which facilitates social support and, in turn, self-efficacy, and a reduction in perceived stress. The third aim of the study was to test the proposed mediation relationship between sociable computer game play-facilitated social support and decreasing perceived stress with self-efficacy (facilitated by an increase in social support) as the mediator.

Therefore, the following seven hypotheses were devised to determine the effectiveness of an intervention that used sociable computer game play to attempt to facilitate social support, self-efficacy, and a reduction in perceived stress as well as to test for the proposed mediated relationship.

H_{4a}: Group activity increases social support over time more than solo activity does.

H_{4b}: Group activity increases self-efficacy over time more than solo activity does.

H_{4c}: Group activity decreases perceived stress over time more than solo activity does.

H_{5a}: Computer game play produces greater levels of social support when compared to no computer game play, but only when the computer game play is sociable.

H_{5b}: Computer game play produces greater levels of self-efficacy when compared to no computer game play, but only when the computer game play is sociable.

H_{5c}: Computer game play produces lower levels of perceived stress when compared to no computer game play, but only when the computer game play is sociable.

H₆: Self-efficacy mediates the effect of social support on perceived stress.

4.3. Method - Study 2

4.3.1. Design.

The present study used an experimental independent measures design; however, some non-random allocation to the study conditions occurred under the same rationale that was described in the method of Study 1 (Section 3.3.4). The independent variable was study condition and included three levels: group, solo, and control. Dependant variables were: (1) social support, (2) generalised self-efficacy, and (3) perceived stress.

4.3.2. Participants.

Eighty-three Teesside University psychology students were recruited using a self-selected sampling strategy; this was achieved using Teesside University's online research participation system in which prospective participants signed-up to timeslots appropriate to their own schedules. A further six participants were recruited opportunistically and were friends or family of the researcher. Individuals under the age of 18 years could not participate.

This sampling strategy resulted in the recruitment of $N = 89$, which consisted of 24 male (26.97%) and 65 female (73.03%) participants whose ages ranged between 18 and 53 ($M = 25.4$; $SD = 8.97$). They were distributed approximately evenly between the three conditions (group, $n = 33$; solo, $n = 23$; and control, $n = 33$).

Prospective power analysis indicated that in order to detect a large effect size $N = 63$, $n = 21$ (power = .80; $f = .40$; $p = .05$) was required (N and n have been increased by 10% to account for potential outliers and other eventualities).

Descriptive statistical information regarding each condition are displayed in Table 4.1.

Table 4.1

Descriptive statistics of the sample by study condition

Condition	<i>n</i>	Sex		Age		
		<i>Male</i>	<i>Female</i>	<i>Range</i>	<i>Mean</i>	<i>SD</i>
Group	33	6 (18.2%)	27 (81.8%)	18–47	24.79	9.57
Solo	23	5 (21.7%)	18 (78.3%)	18–47	25.57	9.75
Control	33	13 (39.4%)	20 (60.6%)	18–53	25.91	7.95

Those who participated within the group study condition did so simultaneously with between one and three other participants in ‘teams’. As such, the group study condition consisted of 12 distinct teams of participants. Descriptive results for each group study condition team are presented in Table 4.2.

Table 4.2

Descriptive statistics of the participant teams within the group study condition

Team	<i>n</i>	Sex		Age		
		<i>Male</i>	<i>Female</i>	<i>Range</i>	<i>Mean</i>	<i>SD</i>
One	3	3	0	19–45	28.33	14.47
Two	2	2	0	18–18	18.00	0.00
Three	3	0	3	19–20	19.33	0.58
Four	2	0	2	46–47	46.50	0.71
Five	2	0	2	18–20	19.00	1.41
Six	4	1	3	18–24	21.25	2.75
Seven	2	0	2	18–18	18.00	0.00
Eight	2	0	2	19–29	24.00	7.07
Nine	4	0	4	23–45	30.75	9.74
Ten	3	0	3	18–45	27.00	15.59
Eleven	3	0	3	20–30	23.33	5.77
Twelve	3	0	3	18–26	21.67	4.04

The data set was screened to identify any instances for, where appropriate, removal of data due to statistical outliers and/or cases of explainable undue influence may have occurred. The procedures and parameters that were used to accomplish this mimic those used in Study 1, an in-depth explanation of which can be found in Section 3.3.2. The data screening process did not identify any instances for appropriate removal of data (Section 4.4.2.).

4.3.3. Materials.

Each participant received an information sheet (Appendices L₁ and L₂), a consent form (Appendix M), and a debrief form (Appendix N). Participants allocated to the group or solo study conditions received standardised instructions (Appendix D). Each participant also received and completed a demographic questionnaire (Appendix O).

The purpose of the information sheet was to explain the purpose and procedure of the study whilst stating the rights of participants in psychological research as stated by the BPS (2014). This facilitated the procurement of fully-informed consent, which was recorded on the administered consent forms. Further to the requirements of the BPS, the debrief form was used to ensure participants were fully debriefed at the end of their research participation. The standardised instructions described the goals, rules, and controls of each of the activities (tennis, bowling, and golf) that are available on the Wii Sports computer game that participants in the group and solo study conditions would be interacting with. The demographic questionnaire consisted of two items, which recorded participant's age and sex. The demographic data were used to gather a demographic understanding of the participant sample as well as a means to enforce the described exclusion criteria.

4.3.3.1. Measures.

Participants in each of the study conditions were asked to complete three measures on a weekly basis across the duration of the experiment: the SSQ6 (Sarason et al., 1987; Appendix F), the General Self-Efficacy Scale ([GSES]

Schwarzer & Jerusalem, 1995; Appendix P), and the Perceived Stress Scale ([PSS] Cohen, Kamarck, & Mermelstein, 1983; Appendix Q).

The SSQ6 was used to measure the dependant variable social support and is comprised of two distinct factors that measure the quantity of received social support (SSQN) and satisfaction with received social support (SSQS). Further information regarding the SSQ6 is described in Study 1's method (Section 3.3.3.1.), which includes a description of the measures items, response method, as well as evidence suggesting the SSQ6 to possess strong internal reliability as well as test-retest variability (Sarason et al., 1987).

The GSES was used to measure the dependant variable perceived self-efficacy (general self-efficacy), it had a single factor structure and consisted of 10 items. Each item presented a scenario related to general day-to-day beliefs about undefined activities, for example item one: I can always manage to solve difficult problems if I try hard enough. Each item required respondents to indicate how true or untrue each particular scenario was to themselves by using a four-point scale (with end-points 'Not at all true' (1) and 'Exactly true' (4). Two items (items three and seven) had their phrasing reversed to be negatively loaded to ensure where proper reading and comprehension of the measure had not occurred could be identified. To score the measure all 10 item responses were summed (after accounting for reverse scored items) resulting in a score of between 10 and 40.

Schwarzer and Jerusalem (1995) indicate that the GSES possesses internal consistency values ranging from $\alpha = .76$ to $.90$ across samples from 23 nations. Evidence has been published to support the GSES as a valid measure, Luszczynska, Gutiérrez-Doña, and Schwarzer (2005) collected data from 8,796 participants from five countries (Costa Rica, Germany, Poland, Turkey, and the

U.S.) and found that positive associations between the GSES and psychological constructs of optimism, self-regulation, self-esteem, and life satisfaction occurred which would be consistent with expected outcomes of higher generalised self-efficacy. Additionally, negative associations between the GSES were found to include depression and anxiety psychological constructs in congruence with expected outcomes of lower generalised self-efficacy.

The PSS was used to measure the dependant variable perceived stress, it had a single factor structure and consisted of 14 items. Each item asked participants to consider over the past month how frequent certain potential stress inducing events occurred, for example item two: In the last month, how often have you felt that you were unable to control the important things in your life? Each item required respondents to indicate how frequently over the course of a month they had engaged in the behaviour described in each statement by using a five-point scale (with end-points 'Never' (0) and 'Very often' (4)). Seven of the PSS items have reversed scales and when scoring the PSS items are summed together (after accounting for reverse scored items), resulting in a score of between 0 and 56.

Cohen et al. (1983) administered the PSS to three independent groups (two student samples and a smoking cessation sample) and measured internal reliability (α) values of .84, .85, and .86, respectively, above the typically accepted minimum internal consistency value of .7. Additionally, validity of the PSS was established by correlating the PSS with measures of similar symptoms (depressive symptomatology and physical symptomatology) and ranged from .52 to .76 representing a large effect (Cohen, 1992). In a review of 19 published articles which involved the use of the PSS, Lee (2012) reported that 11 of the 12 studies reviewed that included the 14-item version of the PSS had internal consistency

values of $>.7$ (internal consistency was not evaluated in the 12th study).

Furthermore, Lee (2012) found evidence of satisfactory test-retest reliability values were reported for the 14-item PSS and concluded that the 14-item PSS has acceptable psychometric properties.

Internal reliability scores for the SSQ6 factors (SSQN and SSQS), the GSES and the PSS during the present study were calculated using Cronbach's α at each point of measurement during the intervention and are displayed in Table 4.3.

Internal consistency scores were found to be at least acceptable ($.7 \leq \alpha < .8$) with the majority of scores being between good ($.8 \leq \alpha < .9$) and excellent ($.9 \leq \alpha$).

Table 4.3

Internal reliability of the SSQ6's factors (SSQN and SSQS), the GSES, and the PSS at each measurement point of the intervention

Time point	SSQ6		GSES	PSS
	SSQN	SSQS		
Baseline	.89	.89	.74	.79
Week 1	.88	.91	.72	.82
Week 2	.93	.91	.78	.83
Week 3	.92	.92	.82	.79
Week 4	.93	.94	.85	.85
Week 5	.93	.92	.84	.88
Week 6	.93	.95	.86	.87
Week 7	.94	.95	.88	.89
Week 8	.93	.94	.87	.86

Note. Internal reliability measured using Cronbach's α ; SSQ6 = (short form) social support questionnaire; SSQN = Social Support Questionnaire number score; SSQS = Social Support Questionnaire satisfaction score; GSES = General Self-Efficacy Scale; PSS = Perceived Stress Scale.

4.3.3.2. Apparatus.

Participants within the group and solo experimental conditions interacted with the computer game *Wii Sports* (developed by Nintendo in 2006), where a ceiling-mounted projector projected the computer game's interface onto a canvas screen (see Figure 4.2. for laboratory layout and depiction of the golf activity available in *Wii Sports*). See apparatus of Study 1 (Section 3.3.3.2.) for further information about the computer game and the Nintendo Wii console that was used to run it.



Figure 4.2. Setup of laboratory and apparatus (Study 2).

4.3.4. Procedure.

The process that was used to allocate participants to the study's conditions was identical to the description of condition allocation in Study 1 (Section 3.3.4.). The study was granted ethics clearance by Teesside University's research ethics committee.

4.3.4.1. Group and solo study conditions.

When participants arrived at the laboratory they were each given an information sheet and a consent form next, the demographic questionnaire was administered. Participants were then given a copy of the SSQ6, GSES, and the PSS to complete in order to attain a baseline measurement.

Participants were then given the standardised instructions to familiarise themselves with the computer game, Wii Sports, and its controls. The standardised instructions informed participants that the Wii Sports activities that were available to play during the experiment included tennis, bowling, and golf while the boxing and baseball games were not available to play during the experiment (see Section 3.3.4.1. for supporting justification).

Participants were then given 30 minutes to play the Wii Sports computer game. They were encouraged to choose amongst themselves (group study condition) or by themselves (solo study condition) which of the three authorised activities that they wished to play and for how long within the 30 minute window (i.e., players could change between tennis, bowling, and golf volitionally).

Following computer game play, participants were asked to complete another copy of the SSQ6, GSES, and PSS. Once these had been completed the experimental session was finished. Participants were asked to return to the laboratory weekly (on the same day and time where possible) in order to participate a further seven times in similar sessions. Experimental sessions after week one involved just the 30 minutes of computer game play and the described measurements following computer game play.

4.3.4.2. Control study condition

When participants arrived at the laboratory they were given an information sheet and consent form to read and complete, which was followed by a demographic questionnaire. Participants were then asked to complete the SSQ6, GSES, and PSS. The session was then finished. Participants were asked to return to the laboratory on a weekly basis in order to complete the same measurements a further seven times. Unlike the group and solo study conditions, participants within the control study condition were not required to complete measurements twice during the first week of the intervention (baseline and week one). This is because the control study condition did not include experimental stimuli (the Wii Sports computer game) and, as such, before (baseline) and after (week one) stimuli exposure measurements could not be made.

Following the eighth laboratory session participants in all conditions were thanked for their participation and were administered a debrief sheet.

4.3.5. Data analysis.

The analytical scope of Study 2 is similar in purpose to that of Study 1, as demonstrated by the similarity of hypotheses that have been generated for both studies. As such, analytical methods involved in Study 2 included 3×2 mixed ANOVA to test hypotheses H_{4a-c} and ANCOVA to test hypotheses H_{5a-c} . Justification for the use of these inferential techniques is provided in Section 4.4. Analyses were also supplemented with MBIs using planned comparisons calculated from both the 3×2 mixed ANOVA and ANCOVA testing (see Section 4.4.3.1. for further information regarding MBI use).

Mediation analysis was used to measure the proposed mediation effect of self-efficacy, derived from social support on reducing perceived stress (H_6). Modern techniques of mediation analysis, which involve the use of bootstrapping techniques, were adopted due to the robust theoretical support (Field, 2017; Hayes, 2018; MacKinnon, 2008; Zhao et al., 2010) that this technique possesses.

To summarise, Table 4.4 outlines the present study's hypotheses alongside the respective analytical methods that were used to test them.

Table 4.4

Study 2 hypotheses and analytical method used to test them

H _#	Statement of outcome	Analysis
H _{4a}	Group activity increases social support over time more than solo activity does.	Mixed 3×2 ANOVA
H _{4b}	Group activity increases self-efficacy over time more than solo activity does.	
H _{4c}	Group activity decreases perceived stress over time more than solo activity does.	
H _{5a}	Computer game play produces greater levels of social support when compared to no computer game play, but only when the computer game play is sociable.	ANCOVA
H _{5b}	Computer game play produces greater levels of self-efficacy when compared to no computer game play, but only when the computer game play is sociable.	
H _{5c}	Computer game play produces lower levels of perceived stress when compared to no computer game play, but only when the computer game play is sociable.	
H ₆	Self-efficacy mediates the effect of social support on perceived stress.	Mediation analysis

4.4. Results - Study 2

The analysis of the data that have been collected during the course of Study 2 are presented in a similar sequence and format to that of the analyses that were presented in Study 1's results (Section 3.4.). Consequently, this results section has been structured so that each analytical test has a dedicated sub-section to contain it in. These are further structured to describe each outcome variable independently (i.e., social support, self-efficacy, and perceived stress). Both factors of the SSQ6 were analysed, as such SSQ6 test outcomes are presented with tests including the SSQN factor first and followed by the SSQS factor.

The initial descriptive analyses (Section 4.4.1) were produced following the data screening process. The parameters that were used in this process as well as specific information regarding the outcomes of data screening are described in detail within the data screening subsection (Section 4.4.2).

Hypotheses H_{4a-c} state that an increase in social support, self-efficacy, and a decrease in perceived stress occurs, over the duration of the intervention, with sociable computer game play more so than with solitary computer game play. To test hypotheses H_{4a-c} inferential analysis involved 3×2 mixed ANOVA in order to test for any difference in changes as a function of treatment through the main effect and also, importantly, for a potential interaction effect between time and treatment. Hypotheses H_{5a-c} state that levels of social support and self-are greater and levels of perceived stress are lower following sociable computer game play, rather than solitary game play, when compared with no computer game play. To test hypotheses H_{5a-c} inferential analysis involved ANCOVA in order to test the

effect of the sociable computer game play treatment against that of solo computer game play and no computer game play.

Mixed ANOVA and ANCOVA were conducted for each outcome variable. Study condition was the independent variable for mixed ANOVA (between-groups) and ANCOVA, which consisted of three levels: group, solo, and control. Time point was an independent variable (within-groups) in mixed ANOVA, which consisted of two levels: initial measurement and week eight measurement. Dependent variables were initial and week eight measurements, for mixed ANOVA, and week eight measurements, for ANCOVA, of social support (SSQN and SSQS), self-efficacy (GSES), and perceived stress (PSS). The covariates tested in ANCOVA were the initial measurement of social support, self-efficacy, and perceived stress (see Section 4.4.3.8. for specific information).

Mixed ANOVA and ANCOVA are supplemented with MBIs to provide further rich information regarding the effect of the intervention. A justification for the use of MBIs and an extensive description of the technique was presented in Study 1's results (Section 3.4.3.1.). Consequently, in order to perform MBI analysis, planned comparisons were carried out for each 3×2 mixed ANOVA and ANCOVA irrespective of the significance value of the overall main effect.

To test hypothesis H₆ mediation analyses were conducted using social support (SSQN/SSQS) as the predictor(s), self-efficacy as the mediator, and perceived stress as the outcome.

4.4.1. Descriptive Analysis.

Initial descriptive analysis involved producing averages and standard deviations for each outcome variable at each measurement point of the eight-week intervention period. This information serves to summarise the collected sample data to provide an initial description of measured observations that were recorded during the intervention.

4.4.1.1. Social Support.

Tables 4.5 and 4.6 display the mean scores and standard deviations of the SSQN and SSQS factors of the SSQ6 for each study condition at each measurement point of the intervention, Figures 4.3. and 4.4. represent this information graphically.

Table 4.5

Mean scores and standard deviations of the SSQN factor of the SSQ6 by study condition at each measurement point of the intervention

Time point	Group		Solo		Control	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Baseline	3.79	1.40	4.25	1.47	-	-
Week 1	3.77	1.40	4.26	1.49	3.32	1.36
Week 2	3.73	1.53	4.36	1.91	3.22	1.26
Week 3	3.53	1.35	4.57	1.94	3.28	1.20
Week 4	3.56	1.48	4.30	2.00	3.10	1.23
Week 5	3.64	1.45	4.38	1.94	3.11	1.22
Week 6	3.53	1.56	4.42	2.07	3.25	1.28
Week 7	3.41	1.42	4.21	2.13	3.21	1.27
Week 8	3.56	1.41	4.53	2.09	3.26	1.14

Note. Data collection for the control study condition began at week one therefore no distinct baseline measurement for this condition was taken.

Initial mean SSQN measurement found that the group and control study conditions had similar scores whereas, the solo study condition was initially recorded to have a larger mean SSQN score. The changes in mean SSQN scores when comparing initial and week eight measurements represent a decrease in the group and control study conditions and an increase in the solo study condition. These changes had below-small effect sizes of $d = -0.17$, 0.16 , and -0.05 for the group, solo, and control study conditions, respectively.

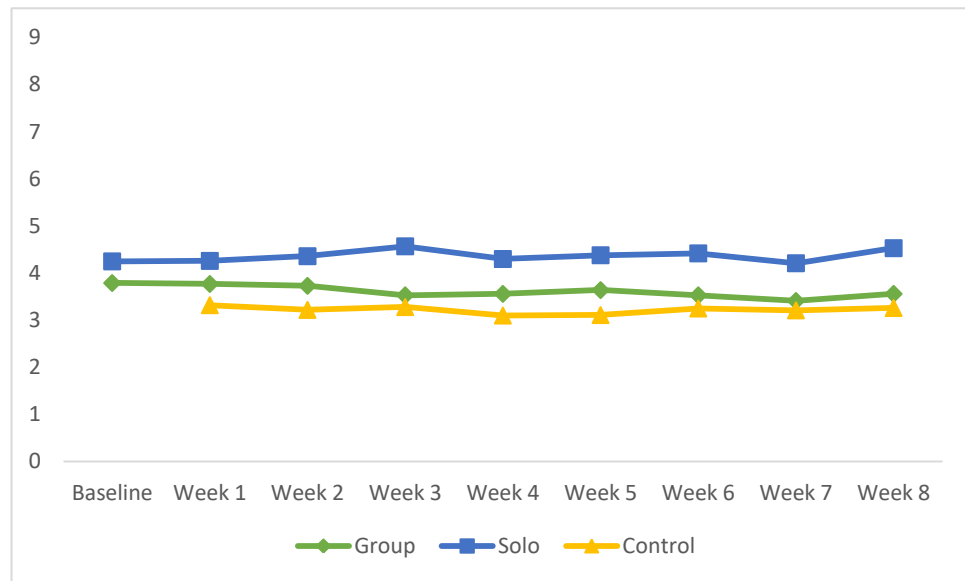


Figure 4.3. Mean scores of the SSQN factor as a function of study condition over time.

Mean SSQN scores were stable across the intervention period with minor variation occurring. Each condition was consistent in that participants within the solo study condition reported the highest SSQN mean scores at each point of the intervention with the group and control study conditions reporting the 2nd-highest and the lowest scores at each measurement point respectively.

Table 4.6

Mean scores and standard deviations of the SSQS factor of the SSQ6 by study condition at each measurement point of the intervention

Time point	Group		Solo		Control	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Baseline	5.16	0.72	5.31	0.56	-	-
Week 1	5.20	0.69	5.28	0.62	5.04	0.83
Week 2	5.24	0.64	5.25	0.61	5.16	0.74
Week 3	5.31	0.62	5.38	0.58	5.23	0.68
Week 4	5.27	0.65	5.42	0.63	5.08	0.74
Week 5	5.21	0.66	5.22	0.78	5.21	0.72
Week 6	5.25	0.64	5.34	0.67	5.17	0.79
Week 7	5.11	0.81	5.20	0.68	5.18	0.73
Week 8	5.26	0.62	5.25	0.71	5.18	0.77

Note. Data collection for the control study condition began at week one therefore no distinct baseline measurement for this condition was taken.

The changes in mean SSQS scores when comparing initial and week eight measurements represent an increase in the group and control study conditions and a decrease in the solo study condition. These changes had below-small effect sizes of $d = 0.15$, -0.17 , and 0.10 for the group, solo, and control study conditions, respectively.

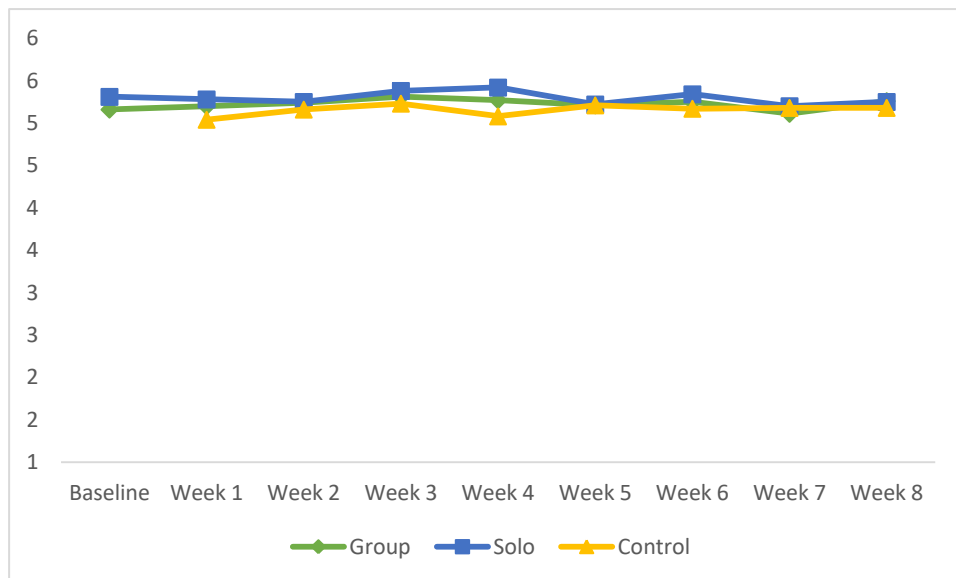


Figure 4.4. Mean scores of the SSQS factor as a function of study condition over time.

Figure 4.4., plots the mean SSQS values that were described in Table 4.6 the group study condition appears to be the most stable with small changes at each measurement increment. The solo and control study condition mean SSQS values, however, varied more often with increases and decreases both occurring. Despite this, mean SSQS scores at the end of the intervention were similar across the conditions.

4.4.1.2. Self-efficacy.

Table 4.7

Mean scores and standard deviations of the GSES by study condition at each measurement point of the intervention

Time point	Group		Solo		Control	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Baseline	28.45	3.94	28.48	3.60	-	-
Week 1	28.48	3.78	29.61	2.71	29.52	3.95
Week 2	29.31	3.59	30.27	2.86	29.39	4.19
Week 3	28.94	4.11	30.04	3.98	30.10	4.20
Week 4	30.23	3.53	29.96	4.16	29.47	4.75
Week 5	29.11	3.68	30.13	3.53	29.63	5.57
Week 6	30.63	3.75	29.75	4.20	28.75	5.68
Week 7	29.79	4.76	29.95	3.20	29.14	5.29
Week 8	30.41	4.05	30.00	3.52	29.76	5.40

Note. Data collection for the control study condition began at week one therefore no distinct baseline measurement for this condition was taken.

The group and solo study conditions appear to have had similar initial mean GSES scores that were less than the control study condition. Each condition increased in mean GSES score by week eight when compared to initial measurement. Effect sizes were found to be medium ($d = 0.50$), small ($d = 0.44$), and below-small ($d = 0.05$) for the group, solo, and control study conditions, respectively.

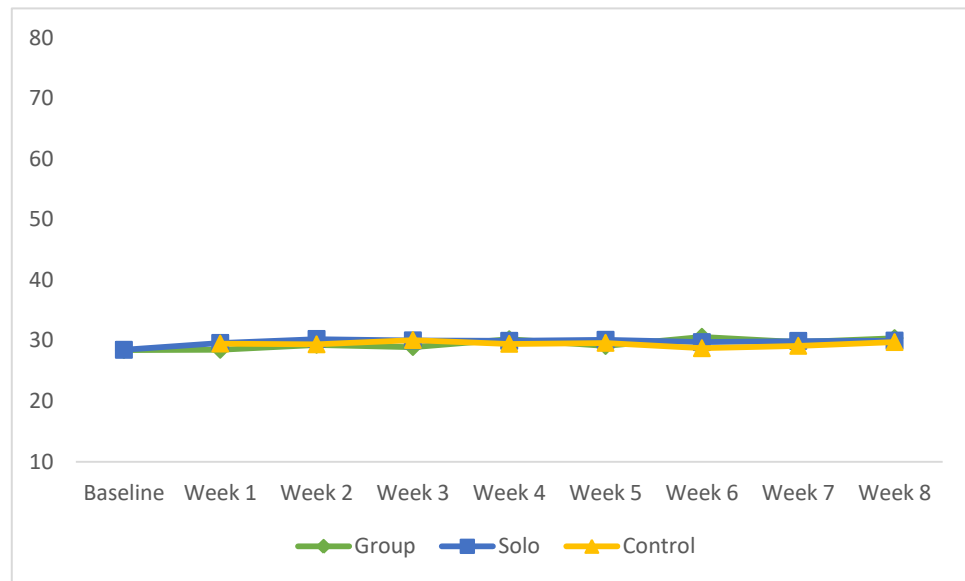


Figure 4.5. Mean scores of the GSES as a function of study condition over time.

Figure 4.5. shows that mean GSES scores across the intervention appear to be stable across the intervention, meaning that mean GSES scores did not vary considerably in any condition at any time point.

4.4.1.3. Perceived Stress.

Table 4.8

Mean scores and standard deviations of the PSS by study condition at each measurement point of the intervention

Time point	Group		Solo		Control	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Baseline	28.03	7.12	27.39	6.37	-	-
Week 1	26.85	6.96	27.30	6.80	28.79	8.06
Week 2	24.93	6.61	24.64	5.74	28.33	8.11
Week 3	25.29	5.36	24.22	6.90	26.13	7.55
Week 4	23.94	5.96	25.30	9.20	26.56	8.16
Week 5	26.57	6.67	24.70	8.43	25.37	10.48
Week 6	23.85	6.18	24.19	7.36	27.11	10.25
Week 7	25.29	7.49	24.75	7.03	27.03	10.69
Week 8	24.84	6.85	24.27	7.73	27.82	9.15

Note. Data collection for the control study condition began at week one therefore no distinct baseline measurement for this condition was taken.

Mean PSS scores at the initial measurement were similar for the group and control study conditions and were larger than those of the solo study condition. Each condition was measured to have decreased in mean PSS score (representing a reduction in perceived stress) by the end of the intervention when compared with their initial measurements. Effect sizes were found to be above-small for the group ($d = -0.46$) and solo study conditions ($d = -0.45$) and below-small for the control study condition ($d = -0.11$).

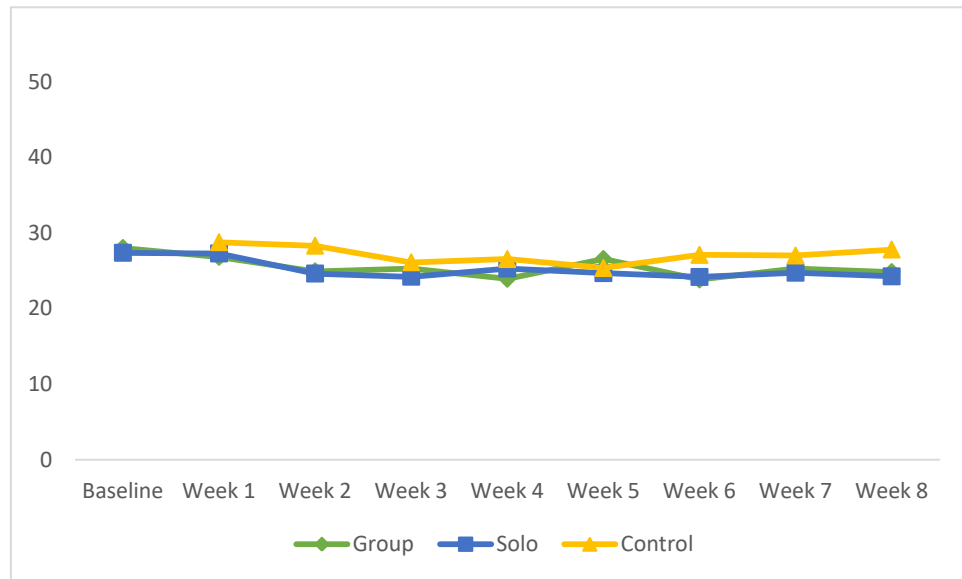


Figure 4.6. Mean scores of the PSS as a function of study condition over time.

A gradual reduction in mean PSS scores can be typically seen in Figure 4.6., across each study condition, especially so at the first four measurement points. Beginning at week four and continuing until the end of the intervention, however, mean PSS scores appear to vary and increase most noticeably of which for the control study condition.

4.4.2. Data screening.

Inferential analysis involved mixed ANOVA and ANCOVA, which were supplemented with MBIs and mediation analysis. Details of their respective outcomes will be presented in this order (Sections 4.4.3.2. for mixed ANOVA, 4.4.3.8. for ANCOVA, and 4.4.3.14. for mediation analysis).

Due to the nature of parametric statistical testing the data must satisfy certain parametric assumptions (first established in Section 3.4.2.). These assumptions and tests to determine if the data are satisfactory (or not) for use are included in this sub-section.

The following parametric assumptions must be satisfied when performing mixed ANOVA and ANCOVA. The dependent variable data need to be recorded at interval or ratio level, sample means need to be normally distributed, independence of scores are required, and homogeneity (and/or sphericity where appropriate) of variances are required. Additionally however, ANCOVA requires that the covariate is independent to the treatment effect and that homogeneity of regression slopes is present.

Initial data screening was carried out to identify if any instances of partial completion of the intervention (participants attending initial laboratory sessions without returning in later weeks) or violation of the study's inclusion criteria had occurred and would warrant removal from the data set; no such cases were found. The next step of the data screening process involved the identification and (where appropriate to do so) removal of outliers. These checks involved visual inspection of histograms and box plots; furthermore, ANCOVAs were conducted as regressions on each outcome variable (SSQN, SSQS, GSES, and PSS) in order to examine standardised residuals and Cook's distance values.

The parameters that were used to identify outliers and cases of undue influence are the same as those that were identified in Study 1 (Section 3.4.2.). For statistical outliers Field (2017) suggests using sample characteristic probabilities, in conjunction with standardised residuals, where in a normal distribution 95% of cases would be expected to have standardised residuals within ± 1.96 and that 99% of cases will present within ± 2.58 . Further to this, Field (2017) argues that any standardised residuals that fall outside of these probabilities as well as those that are greater than ± 3.29 are sufficient for investigation. To identify cases of undue influence using Cook's distance a cut-off parameter value was calculated

for each condition, due to differences in the number of cases between conditions, using the equation $4/n$ (Bollen & Jackman, 1990), which equalled 0.13 for the group study condition, 0.18 for the solo study condition, and 0.12 for the control study condition.

During the data screening process, a number of statistical outliers were detected; however, their frequency of occurrence was within acceptable tolerance based on the described sample characteristic probabilities. Additionally, two cases were identified with Cook's distance values (1.46 and 0.94) considerably above their condition's $4/n$ cut-off (0.12). However, upon investigation there was no justifiable reason to take any further action, this was because the data did not appear to be erroneously recorded or reasonably attributable to outside influence and, as such, it was possible that these cases were legitimate data. As such, the data screening-process did not result in the removal of any cases. The data were found to be within acceptable parameters of distribution by visual inspection of histograms (satisfying the parametric assumption of equal distribution of scores).

The covariates under investigation were found to be independent of the experimental effect. This was determined by conducting a series of ANOVAs with each covariate entered, independently, as dependent variables and study condition as the independent variable. Study condition was found not to have a statistically significant relationship with any covariate as can be seen in Table 4.9, thereby satisfying the parametric assumption of independence of the covariate for ANCOVA testing.

Table 4.9

Test of the independence of covariate parametric assumption in ANCOVA

Covariate	ANOVA outcome
SSQN	$F(2, 86) = 3.01, p = .055$
SSQS	$F(2, 86) = 0.94, p = .395$
GSES	$F(2, 86) = 0.77, p = .466$
PSS	$F(2, 86) = 0.25, p = .776$

Note. SSQN = Social Support Questionnaire number score; SSQS = Social Support Questionnaire satisfaction score; GSES = General Self-Efficacy Scale; PSS = Perceived Stress Scale.

The remaining parametric assumptions to be tested are homogeneity of variance (or sphericity where appropriate) and homogeneity of regression slopes. First, the homogeneity of variance assumption was tested using Levene's test and variance ratios (Hartley's F_{\max} test) as per the recommendations of Field (2016, 2017). The outcome of the Levene's test as well as each outcome variable's associated variance ratio is presented in Tables 4.10 and 4.11 and were conducted as part of the 3×2 mixed ANOVA (Table 4.10) and ANCOVA (Table 4.11) tests that were described at the beginning of this section, respectively. As explained previously (Section 3.4.2.), variance ratio cut-off values for comparison to a sampling distribution of F_{\max} table were calculated using linear interpolation to identify precise values for the specific number of degrees of freedom for each condition (see Appendix R). The relevant variance ratio cut-off values were calculated to be 2.90 ($df = 21$), 2.84 ($df = 22$), 2.38 ($df = 31$), and 2.36 ($df = 32$).

Table 4.10

Homogeneity of variance test for 3×2 mixed ANOVA and associated variance ratios

Outcome variable	Initial measurement		Week eight measurement	
	Levene's test	Variance ratio	Levene's test	Variance ratio
SSQN	$F(2, 84) = 0.17, p = .842$	1.17	$F(2, 84) = 3.82, p = .026$	3.33
SSQS	$F(2, 84) = 1.79, p = .174$	2.18	$F(2, 84) = 0.08, p = .928$	1.52
GSES	$F(2, 84) = 0.77, p = .468$	1.20	$F(2, 84) = 1.99, p = .143$	2.35
PSS	$F(2, 84) = 0.96, p = .387$	1.60	$F(2, 84) = 0.63, p = .535$	1.79

Note. SSQN = Social Support Questionnaire number score; SSQS = Social Support Questionnaire satisfaction score; GSES = General Self-Efficacy Scale; PSS = Perceived Stress Scale.

The Levene's test statistic was violated when conducting 3×2 mixed ANOVA on the SSQN outcome variable for the week eight measurement; the associated variance ratio was larger than its' calculated cut-off of 2.36 ($df = 32$), as consequently it is when conducting ANCOVA (Table 4.11).

Table 4.11

Homogeneity of variance test for ANCOVA and associated variance ratios

Outcome variable	Levene's test	Variance ratio
SSQN	$F(2, 84) = 2.10, p = .129$	3.33
SSQS	$F(2, 84) = 2.64, p = .077$	1.52
GSES	$F(2, 84) = 0.29, p = .750$	2.35
PSS	$F(2, 84) = 0.11, p = .897$	1.79

Note. SSQN = Social Support Questionnaire number score; SSQS = Social Support Questionnaire satisfaction score; GSES = General Self-Efficacy Scale; PSS = Perceived Stress Scale.

Although the variance ratio of the SSQN outcome variable exceeded its respective cut-off, there was no violation of Levene's test for SSQN or other outcome variables when conducting ANCOVA.

Therefore, the SSQN outcome variable was considered to be heterogeneous during 3×2 mixed ANOVA and was therefore tested using a more stringent significance level (from $\alpha = .05$ to $\alpha = .025$) to account for the increase in probability of making a Type I error that variance heterogeneity can lead to (Keppel, 1991).

Second, the assumption of homogeneity of regression slopes was tested by conducting an ANCOVA for each outcome variable while including an interaction effect between the independent variable (study condition) and covariate (initial outcome measurement), the (non)significance of which determines if the assumption is violated or not. Of the four ANCOVAs that were conducted, one was found to have a significant interaction effect. This was for the SSQN factor of the SSQ6 which has violated the assumption of homogeneity of regression slopes. The assumption was satisfied for all other outcome measures however (see Table 4.12).

Table 4.12

Homogeneity of regression slopes test using ANCOVA interaction between study condition and covariates

Outcome variable	ANCOVA interaction effect
SSQN	$F(2, 81) = 8.94, p < .001$
SSQS	$F(2, 81) = 2.08, p = .131$
GSES	$F(2, 81) = 2.27, p = .110$
PSS	$F(2, 81) = 1.76, p = .179$

Note. SSQN = Social Support Questionnaire number score; SSQS = Social Support Questionnaire satisfaction score; GSES = General Self-Efficacy Scale; PSS = Perceived Stress Scale.

It is suggested that violating the homogeneity of regression slopes assumption does not necessarily mean that ANCOVA cannot be conducted. Earlier simulation research by Peckham (1986), and Glass et al. (1972) suggests that for a one-

factor fixed-effect model, the effect of heterogeneous regression slopes will be minimal. Furthermore, Harwell (2003) argued that the effect of non-homogenous regression slopes on the F -test is modest where there are unequal covariate means (such as in nonrandomized studies) and where the number of participants between conditions are unequal. Therefore, an ANCOVA including the SSQN as a dependent variable was conducted.

4.4.3. Inferential analysis.

In order to test each dependent variable that was under investigation, each inferential test was carried out four times (to include SSQN, SSQS, GSES, and PSS). The outcomes of these tests are presented in the same order as that was used when describing descriptive data and data screening procedures.

Specifically, the following order was used: social support (broken into SSQN and SSQS sub-sections), self-efficacy, and perceived stress. Effect size measurements (partial η^2 , Cohen's d , and Pearson's r) have been included; for interpretation, the conventions (Clark-Carter, 2002; Cohen, 1998; Field, 2017) for the effect size are small ($\eta^2 = .01$, $d = 0.2$, $r = .10$), medium ($\eta^2 = .06$, $d = 0.5$, $r = .30$), and large ($\eta^2 = .14$, $d = 0.8$, $r = .50$).

4.4.3.1. Magnitude-based inferences.

MBIs were calculated using information that was supplied by the simple contrasts produced from the 3×2 mixed ANOVA tests (Section 4.3.3.2.) and ANCOVA tests (Section 4.3.3.8.), the outcomes of which are presented after their respective inferential test. Each MBI was made with reference to the smallest worthwhile change, this was calculated by multiplying the pooled variance of each comparison by 0.2; the calculated values for the smallest worthwhile change for each

comparison can be found in Appendix S. Additionally, see Section 3.4.3.1., for further information regarding the qualitative assessment of mechanistic and clinical inferences. Hypotheses H_{5c} and H_{7c} state that group activity decreases perceived stress when compared to solo activity and that following group activity lower levels of perceived stress are present when compared to solo activity, respectively. As such, the MBIs with the PSS as the dependent variable are reported with effect sizes that have been reversed to reflect that a lower PSS score is reported as positive/beneficial and a higher PSS score is reported as negative/harmful.

4.4.3.2. Mixed ANOVA.

Similarly to Study 1, a 3×2 (study condition x measurement point) mixed ANOVA design was employed here where study condition (group, solo, or control) was the between-subjects factor and measurement time point (initial and week eight measurements) was the within-subjects factor. The purpose of these mixed ANOVA was to test hypotheses H_{4a-c} . Therefore, a set of planned comparisons using simple contrasts were conducted for each mixed ANOVA which compared the group study condition with the solo study condition. In addition, the interactions between treatment (study condition) and time (initial and week eight measurement) are also reported.

4.4.3.3. Social support.

4.4.3.3.1. SSQN.

The main effect of measurement time point on SSQN score was non-significant, $F(1, 84) = 0.01$, $p = .935$, partial $\eta^2 = .00$. SSQN score did not significantly change from initial measurement ($M = 3.72$; $SD = 1.43$) to week eight ($M = 3.69$; $SD = 1.59$).

The effect of study condition was significant, $F(2, 84) = 4.06$, $p = .021$, partial $\eta^2 = .09$, indicating that SSQN score differed between study conditions. The planned contrast comparing the group and solo study conditions, was significant, $t(84) = -2.29$, $p = .024$, $r = .24$, indicating that the group study condition ($M = 3.56$; $SD = 1.41$) had lower SSQN mean scores than the solo study condition ($M = 4.53$; $SD = 2.09$).

There was a non-significant interaction effect between measurement time point and study condition on SSQN score, $F(2, 84) = 1.97$, $p = .146$, partial $\eta^2 = .05$; therefore, changes in SSQN score over time did not differ between study conditions.

4.4.3.3.2. SSQS.

The main effect of measurement time point on SSQS score was non-significant, $F(1, 84) = 1.45$, $p = .232$, partial $\eta^2 = .02$. SSQS score did not significantly change from initial measurement ($M = 5.15$; $SD = .73$) to week eight ($M = 5.23$; $SD = .70$).

The effect of study condition was non-significant, $F(2, 84) = 0.41$, $p = .667$, partial $\eta^2 = .01$, indicating that SSQS score did not differ between study conditions. The planned contrast comparing the group and solo study conditions, was non-significant, $t(84) = 0.05$, $p = .957$, $r = .01$, indicating that the group study condition ($M = 5.26$; $SD = 0.62$) and the solo study condition ($M = 5.25$; $SD = 0.71$) did not differ in SSQS mean score.

There was a non-significant interaction effect between measurement time point and study condition on SSQS score, $F(2, 84) = 0.84$, $p = .435$, partial $\eta^2 = .02$, therefore changes in SSQS score over time did not differ between study conditions.

4.4.3.4. Self-efficacy.

The main effect of measurement time point on GSES score was significant, $F(1, 84) = 5.61$, $p = .020$, partial $\eta^2 = .06$. GSES score significantly increased from initial measurement ($M = 28.99$; $SD = 3.78$) to week eight ($M = 30.06$; $SD = 4.46$).

The effect of study condition was non-significant, $F(2, 84) = 0.03$, $p = .967$, partial $\eta^2 = .00$, indicating that GSES score did not differ between study conditions. The planned contrast comparing the group and solo study conditions, was non-significant, $t(84) = 0.58$, $p = .563$, $r = .06$, indicating that the group study condition ($M = 30.41$; $SD = 4.05$) and the solo study condition ($M = 30.00$; $SD = 3.52$) did not differ in GSES score.

There was a non-significant interaction effect between measurement time point and study condition on GSES score, $F(2, 84) = 1.14$, $p = .326$, partial $\eta^2 = .03$, therefore changes in GSES score over time did not differ between study conditions.

4.4.3.5. Perceived stress.

The main effect of measurement time point on PSS score was significant, $F(1, 84) = 5.40$, $p = .023$, partial $\eta^2 = .06$. PSS score significantly decreased from initial measurement ($M = 27.91$; $SD = 7.15$) to week eight ($M = 25.83$; $SD = 8.07$).

The effect of study condition was non-significant, $F(2, 84) = 1.44$, $p = .243$, partial $\eta^2 = .03$, indicating that PSS score did not differ between study conditions. The planned contrast comparing the group and solo study conditions, was non-significant, $t(84) = -1.50$, $p = .138$, $r = .16$, indicating that the group study condition ($M = 24.84$; $SD = 6.85$) and the solo study condition ($M = 24.27$; $SD = 7.74$) did not differ in PSS score.

There was a non-significant interaction effect between measurement time point and study condition on PSS score, $F(2, 84) = 0.46$, $p = .636$, partial $\eta^2 = .01$, therefore changes in PSS score over time did not differ between study conditions.

4.4.3.6. MBIs for 3×2 mixed ANOVA.

Tables 4.12 and 4.13 describe the MBIs that were calculated to supplement the conducted 3×2 mixed ANOVAs that were carried out to test hypotheses H5_{a-c} by providing further probabilistic information. Table 4.13 presents the quantitative outcomes of the MBIs and the associated qualitative mechanistic inferences. Table 4.14 presents the associated qualitative clinical inferences for each of the MBIs in Table 4.13.

Table 4.13

Magnitude-based mechanistic inferences calculated from simple contrasts from 3×2 mixed ANOVA

Outcome variables	Raw data; mean ± (SD)		% probability of positive/negligible/negative	Between-condition differences		
	Group	Solo		ES	%; ±90% CL	Qualitative mechanistic inference
SSQN	3.56 ± (1.41)	4.53 ± (2.09)	0.1/7/92.9	.24	-0.97; ±0.7	Likely negative.
SSQS	5.26 ± (0.62)	5.25 ± (0.71)	26.5/50.4/23.1	.01	0.01; ±0.32	Unclear; get more data.
GSES	30.41 ± (4.05)	30 ± (3.52)	38.6/44/17.4	.04	0.41; ±2.1	Unclear; get more data.
PSS	24.84 ± (6.85)	24.27 ± (7.73)	18.4/46.8/34.8	.03	0.57; ±3.7	Unclear; get more data.

Note. SSQN = Social Support Questionnaire number score; SSQS = Social Support Questionnaire satisfaction score; GSES = General Self-Efficacy Scale; PSS = Perceived Stress Scale; ES = effect size (*r*); CL = confidence limits; ±90% CL: add and subtract this number to the mean effect to obtain the 90% confidence limits for the true difference; PSS effect sizes have been reversed to reflect that a reduction in PSS score is positive; dividers between outcome variables included for clarity.

Table 4.14

Qualitative clinical inferences of MBIs performed in Table 4.13

Outcome variables	Qualitative clinical inferences for group study condition
SSQN	Likely harmful, most unlikely beneficial; don't use .
SSQS	Unclear; don't use get more data.
GSES	Unclear; don't use get more data.
PSS	Possibly harmful, unlikely beneficial; don't use .

Note. SSQN = Social Support Questionnaire number score; SSQS = Social Support Questionnaire satisfaction score; GSES = General Self-Efficacy Scale; PSS = Perceived Stress Scale.

4.4.3.7. Summary of 3×2 mixed ANOVA and associated MBIs.

Out of the four conducted 3×2 mixed ANOVA tests significant differences of the main effect (measurement time point on outcome) were found for the self-efficacy and perceived stress outcomes, which suggest that GSES score increased, and PSS score decreased between the initial measurement and week eight of the intervention. Additionally, significant effects were found for the SSQN outcome when comparing the group and solo study conditions suggesting that the group study condition had lower social support (SSQN) than the solo study condition. All other tested effects, including interaction effects, were found to be non-significant.

To provide further rich information on the outcome of the 3×2 mixed ANOVA testing, MBIs were performed. The findings presented in Table 4.13 which represents the simple contrasts between the group and solo study conditions describe the SSQN comparison between the group and solo study conditions to be likely negative (between 75%-95% probability). Otherwise, all other comparisons were considered for further data collection as the inference was unclear.

The clinical inferences (Table 4.14) may be more meaningful practically speaking; when comparing the group and solo study conditions, the group intervention was not recommended for use in any of the comparisons. The comparison between the group and solo study conditions for PSS had a qualitative mechanistic description of being unclear however, the same comparison was clinically considered to be possibly harmful and unlikely to be beneficial. Furthermore, the intervention was considered to be likely harmful and most unlikely beneficial when comparing the group and solo study conditions for SSQN.

H_{4a-c} stated that sociable computer game play would increase social support, self-efficacy, and decrease perceived stress over time more so than solo computer game play. Following 3×2 mixed ANOVA, H_{4a}, H_{4b}, and H_{4c} have each been rejected, due to the non-significance of their respective interaction effects and the simple contrasts that were performed between the group and solo study conditions or, as is the case for H_{4a}, where a significant effect was found but not in the stated direction (solo SSQN was found to be significantly larger than group SSQN).

See Table 4.20 (Section 4.4.4.) for a summary of the outcome of 3×2 mixed ANOVA testing on hypotheses H_{4a-c}, which are supported with their associated qualitative mechanistic and clinical inferences from MBI testing.

4.4.3.8. ANCOVA.

Each of the study's outcome variables (SSQN, SSQS, GSES, and PSS) were involved in an ANCOVA, the covariates that were involved within the ANCOVA were the initial measurements recorded for the SSQ6 (SSQN and SSQS), GSES, and PSS. The justification for including initial measurements as covariates for ANCOVA was to account for the potential confounding effect of participants' levels

of social support, general self-efficacy, and perceived stress prior to experimental manipulation.

The purpose of conducting ANCOVA was to test hypotheses H_{5a-c} , which stated that social support and self-efficacy would be greater and perceived stress would be lower following specifically sociable computer game play in comparison to both solo and no computer game play. As such, comparisons were made to first, compare sociable computer game play with solo computer game play, and second, to compare solo computer game play with no computer game play. The purpose of which was to establish that computer game play in general is not facilitative of positive health-related behaviour change but, rather, that sociable computer game play is.

4.4.3.9. Social support.

4.4.3.9.1. SSQN.

The covariate, initial SSQN score, was significantly related to the week eight SSQN score, $F(1, 83) = 82.54, p < .0001, r = .71$. There was a non-significant effect of study condition on week eight SSQN score after controlling for the effect of initial SSQN score, $F(2, 83) = 2.98, p = .056, \text{partial } \eta^2 = .07$.

Simple planned contrasts revealed that group activity ($M = 3.56; SD = 1.41$) had significantly lower SSQN score when compared to solo activity ($M = 4.53; SD = 2.09$), $t(83) = -2.31, p = .023, r = .25$, and solo activity had significantly higher SSQN score when compared to no activity (the control group; $M = 3.26; SD = 1.14$), $t(83) = 2.02, p = .047, r = .22$.

4.4.3.9.2. SSQS.

The covariate, initial SSQS score, was significantly related to the week eight SSQS score, $F(1, 83) = 135.69$, $p < .0001$, $r = .79$. There was a non-significant effect of study condition on week eight SSQS score after controlling for the effect of initial SSQS score, $F(2, 83) = 0.43$, $p = .655$, partial $\eta^2 = .01$.

Simple planned contrasts revealed that group activity ($M = 5.26$; $SD = 0.62$) did not significantly differ in SSQS score when compared to solo activity ($M = 5.25$; $SD = 0.71$), $t(83) = 0.70$, $p = .485$, $r = .08$, and solo activity did not significantly differ in SSQS score when compared to no activity ($M = 5.18$; $SD = 0.77$), $t(83) = 0.90$, $p = .371$, $r = .10$.

4.4.3.10. Self-efficacy.

The covariate, initial GSES score, was significantly related to the week eight GSES score, $F(1, 83) = 26.13$, $p < .0001$, $r = .49$. There was a non-significant effect of study condition on week eight GSES score after controlling for the effect of initial GSES score, $F(2, 83) = 0.72$, $p = .488$, partial $\eta^2 = .02$.

Simple planned contrasts revealed that group activity ($M = 30.41$; $SD = 4.05$) did not significantly differ in GSES score when compared to solo activity ($M = 30.00$; $SD = 3.52$), $t(83) = 0.47$, $p = .642$, $r = .05$, and solo activity did not significantly differ in GSES score when compared to no activity ($M = 29.76$; $SD = 5.40$), $t(83) = 0.62$, $p = .539$, $r = .07$.

4.4.3.11. Perceived stress.

The covariate, initial PSS score, was significantly related to the week eight PSS score, $F(1, 83) = 13.89$, $p < .0001$, $r = .38$. There was a non-significant effect of

study condition on week eight PSS score after controlling for the effect of initial PSS score, $F(2, 83) = 1.25$, $p = .292$, partial $\eta^2 = .03$.

Simple planned contrasts revealed that group activity ($M = 24.84$; $SD = 6.85$) did not significantly differ in PSS score when compared to solo activity ($M = 24.27$; $SD = 7.74$), $t(83) = 0.13$, $p = .894$, $r = .01$, and solo activity did not significantly differ in PSS score when compared to no activity ($M = 27.82$; $SD = 9.15$), $t(83) = -1.34$, $p = .183$, $r = .15$.

4.4.3.12. MBIs for ANCOVA.

Tables 4.15 and 4.16 describe the MBIs that were calculated to test hypotheses H_{5a-c} , and involved simple planned contrasts that compared the group study condition with the solo study condition and the solo study condition with the control study condition. Table 4.15 presents the quantitative outcomes of the MBIs and the associated qualitative mechanistic inferences. Table 4.16 presents the qualitative clinical inferences for each of the MBIs in Table 4.15.

Table 4.15

Magnitude-based mechanistic inferences calculated from simple contrasts from ANCOVA

Outcome variables	IV conditions	Raw data; mean \pm (SD)			ES	Between-condition differences	
		Group or Control	Solo	% probability of beneficial/trivial/harmful ^a		%; \pm 90% CL	Qualitative mechanistic inference
SSQN	Group vs solo	3.56 \pm (1.41)	4.53 \pm (2.09)	0.1/6.8/93.1	.25	-0.97; \pm 0.69	Likely negative
	Solo vs control	3.26 \pm (1.14)		93.3/6/0.7	.22	1.3; \pm 1	Likely positive
SSQS	Group vs solo	5.26 \pm (0.62)	5.25 \pm (0.71)	0/100/0	.08	0.01; \pm 0.03	Most likely trivial
	Solo vs control	5.18 \pm (0.77)		17.6/82/0.4	.10	0.07; \pm 0.14	Likely trivial
GSES	Group vs solo	30.41 \pm (4.05)	30 \pm (3.52)	33.9/57/9	.05	0.41; \pm 1.4	Unclear; get more data
	Solo vs control	29.76 \pm (5.40)		3.8/96/0.2	.07	0.24; \pm 0.65	Very likely trivial
PSS	Group vs solo	24.84 \pm (6.85)	24.27 \pm (7.73)	41.9/26.1/31.9	.01	0.57; \pm 7.1	Unclear; get more data
	Solo vs control	27.82 \pm (9.15)		2.5/22.1/75.4	.15	-3.5; \pm 4.4	Likely negative

Note. SSQN = Social Support Questionnaire number score; SSQS = Social Support Questionnaire satisfaction score; GSES = General Self-Efficacy Scale; PSS = Perceived Stress Scale; ES = effect size (r); CL = confidence limits; \pm 90% CL: add and subtract this number to the mean effect to obtain the 90% confidence limits for the true difference; PSS effect sizes have been reversed to reflect that a reduction in PSS score is positive; dividers between outcome variables included for clarity.

^aValues may not sum to 100% due to rounding to one decimal place.

Table 4.16

Qualitative clinical inferences of MBIs performed in Table 4.15

Outcome variables	IV condition comparison	Qualitative clinical inference
SSQN	Group vs solo	Likely harmful, most unlikely beneficial; don't use .
	Solo vs control	Likely beneficial, very unlikely harmful; use .
SSQS	Group vs solo	Most unlikely beneficial, most unlikely harmful; use .
	Solo vs control	Most unlikely harmful, unlikely beneficial; don't use .
GSES	Group vs solo	Unclear; don't use ; get more data.
	Solo vs control	Most unlikely harmful, very unlikely beneficial; don't use .
PSS	Group vs solo	Unclear; don't use ; get more data.
	Solo vs control	Likely harmful, very unlikely beneficial; don't use .

Note. SSQN = Social Support Questionnaire number score; SSQS = Social Support Questionnaire satisfaction score; GSES = General Self-Efficacy Scale; PSS = Perceived Stress Scale; dividers between outcome variables included for clarity.

4.4.3.13. Summary of ANCOVA and associated MBIs.

Each of the covariates (initial measurements) were found to be significantly related to their respective week eight measurements, which is in line with expectations.

The two planned contrasts carried out with SSQN as the outcome variable were significant and revealed that the solo study condition ($M = 4.53$; $SD = 2.09$) had a greater SSQN score than the group ($M = 3.56$; $SD = 1.41$), and the control ($M = 3.26$; $SD = 1.14$) conditions. All other planned contrasts yielded statistically non-significant results. Further to these findings, each ANCOVA found statistically non-significant effects for study condition on week eight scores.

The performed MBIs, however, provide more valuable and richer information on the outcomes of the ANCOVA testing and simple contrasts that were performed.

When comparing the group intervention against solo activity qualitative

mechanistic inference (Table 4.15) considered the intervention to be likely negative (SSQN), most likely trivial (SSQS), and unclear (GSES and PSS).

Qualitative mechanistic inferences considered solo activity to be likely positive (SSQN), likely trivial (SSQS), very likely trivial (GSES), and likely negative when compared with no activity (control study condition).

The qualitative clinical inferences (Table 4.16) recommended the intervention for use in two of the eight performed comparisons. These instances occurred for comparisons made between the solo and control study conditions for SSQN (likely beneficial and very unlikely harmful) and the group and solo study condition for SSQS (most unlikely beneficial and most unlikely harmful).

H_{5a-c} stated that computer game play would produce greater levels of social support and self-efficacy and lower levels of perceived stress when compared to no computer game play, but only when the computer game play is sociable.

Following ANCOVA, H_{5a}, H_{5b}, and H_{5c} have each been rejected, either due to the non-significance of the simple contrasts that were made between the group and solo study conditions or, as is the case for H_{5a}, where a significant effect was found but, not in the stated direction (solo SSQN was found to be significantly larger than group SSQN). However, ANCOVA findings did provide evidence to suggest that the solo and control study condition did not differ in measurements of SSQS, GSES, and PSS, which was predicted by H_{5a}, H_{5b}, and H_{5c} due to their statements of expected change occurring only with sociable computer game play. Despite this, it was appropriate to reject H_{5a}, H_{5b}, and H_{5c} due to described findings concerning the treatment effect of sociable computer game play.

See Table 4.21 and Table 4.22 (Section 4.4.4.) for a summary of the outcome of ANCOVA testing on hypotheses H_{5a-c} , which are supported with their associated qualitative mechanistic and clinical inferences from MBI testing.

4.4.3.14. Mediation analysis.

To test hypothesis H_6 and the theoretically proposed mediation relationship (Figure 4.7.) between the dependent variables social support (as predictor), self-efficacy (as mediator), and perceived stress (as outcome), mediation analyses were conducted using the PROCESS macro (Hayes, 2016) for SPSS. The analyses were conducted using the modern techniques outlined by Field (2017), Hayes (2018), and MacKinnon (2008) which tests the indirect effect of the relationship, that is, the effect of social support on the perceived stress outcome measure through self-efficacy. Interpretation of tests of mediation were made using Zhao et al.'s (2010) typology of mediations and non-mediations (Section 3.4.3.14.).

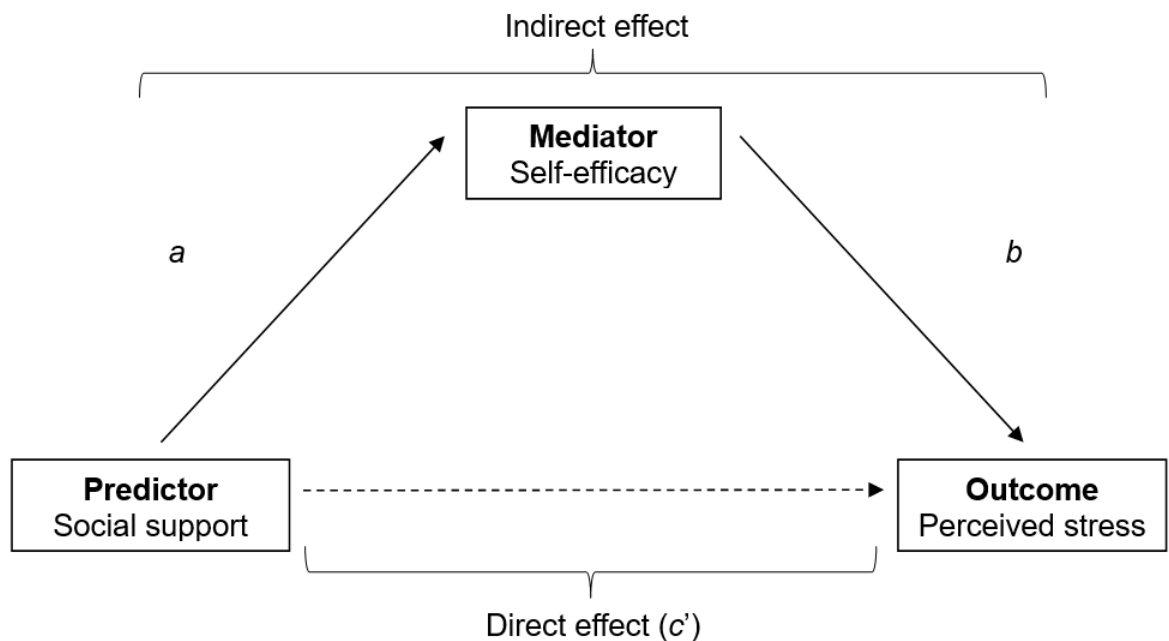


Figure 4.7. Proposed mediation model (Study 2).

A series of mediation analyses was conducted, testing each of the study conditions as well as both factors of the SSQ6 (SSQN and SSQS), as shown in Figure 4.7. The predictor (social support) used data from the week six SSQ6 measurements (SSQS or SSQN factors); the mediator (self-efficacy) used data from the week seven GSES measurements; and the outcome (perceived stress) used data from week eight PSS measurements. The rationale for using these time points within the mediation analysis was that any changes experienced in social support would be seen to impact self-efficacy at the subsequent measurement point, and so-on for perceived stress (being affected by changes in self-efficacy). As such, each mediation analysis was performed initially with SSQN as the predictor and again but with SSQS as the predictor; this procedure was repeated for each of the study conditions which resulted in six analyses being conducted.

4.4.3.14.1. Group study condition SSQN and SSQS.

For the group study condition, there was a non-significant indirect effect of SSQN score on perceived stress through self-efficacy, $b = 0.25$, BCa CI(95%) = [-1.50, 1.65], $R^2 = .37$, indicating that mediation did not occur.

There was a significant negative indirect effect of SSQS score on perceived stress through self-efficacy, $b = -3.75$, BCa CI(95%) = [-7.91, -1.25], $R^2 = .39$, indicating that mediation occurred.

The outcomes of the group study condition mediation analyses including the unstandardised regression coefficients represented as a , b , and c' in Figure 4.7., are presented in Table 4.17.

Table 4.17

Unstandardised regression coefficients for the group study condition with SSQN and SSQS as the predictor including interpretation of effects.

Predictor	Indirect effect	a, b and direct effect (in respective order)	Interpretation (Zhao et al., 2010)
		$b = -0.29, p = .654$	
SSQN	$b = 0.25$, BCa CI [-1.50, 1.65], $R^2 = .37$	$b = -0.87, p = .002$ $b = -0.14, p = .852$	No-effect mediation
		$b = 3.85, p = .013$	
SSQS	$b = -3.75$, BCa CI [-7.91, -1.25], $R^2 = .39$	$b = -0.96, p = .002$ $b = 1.66, p = .452$	Indirect-only mediation

Note. The confidence interval for the indirect effect is a BCa bootstrapped CI based on 5,000 samples.

4.4.3.14.2. Solo study condition SSQN and SSQS.

For the solo study condition there was a significant negative indirect effect of SSQN score on perceived stress through self-efficacy, $b = -1.31$, BCa CI(95%) = [-2.53, -0.36], $R^2 = .40$, indicating that mediation occurred.

There was a significant negative indirect effect of SSQS score on perceived stress through self-efficacy, $b = -2.54$, BCa CI(95%) = [-6.30, -0.17], $R^2 = .49$, indicating that mediation occurred.

The outcomes of the solo study condition mediation analyses including the unstandardised regression coefficients represented as a , b , and c' in Figure 4.7., are presented in Table 4.18.

Table 4.18

Unstandardised regression coefficients for the solo study condition with SSQN and SSQS as the predictor including interpretation of effects.

Predictor	Indirect effect	a, b and direct effect (in respective order)	Interpretation (Zhao et al., 2010)
		$b = 0.99, p = .006$	
SSQN	$b = -1.31$, BCa CI [-2.53, -0.36], $R^2 = .40$	$b = -1.33, p = .031$ $b = -0.14, p = .875$	Indirect-only mediation
		$b = 2.58, p = .026$	
SSQS	$b = -2.54$, BCa CI [-6.30, -0.17], $R^2 = .49$	$b = -0.99, p = .054$ $b = -3.76, p = .127$	Indirect-only mediation

Note. The confidence interval for the indirect effect is a BCa bootstrapped CI based on 5,000 samples.

4.4.3.14.3. Control study condition SSQN and SSQS.

For the control study condition there was a non-significant indirect effect of SSQN score on perceived stress through self-efficacy, $b = .94$, BCa CI(95%) = [-.98, 3.24], $R^2 = .52$, indicating that mediation did not occur.

There was a non-significant indirect effect of SSQS score on perceived stress through self-efficacy, $b = -0.37$, BCa CI(95%) = [-3.50, 2.45], $R^2 = .46$, indicating that mediation did not occur.

The outcomes of the solo study condition mediation analyses including the unstandardised regression coefficients represented as a , b , and c' in Figure 4.7., are presented in Table 4.19.

Table 4.19

Unstandardised regression coefficients for the control study condition with SSQN and SSQS as the predictor including interpretation of effects.

Predictor	Indirect effect	a, b and direct effect (in respective order)	Interpretation (Zhao et al., 2010)
		$b = -0.77, p = .382$	
SSQN	$b = 0.94$, BCa CI [-.98, 3.24], $R^2 = .52$	$b = -1.22, p = .000$ $b = -1.82, p = .100$	No-effect mediation
		$b = 0.33, p = .816$	
SSQS	$b = -0.37$, BCa CI [-3.50, 2.45], $R^2 = .46$	$b = -1.14, p = .000$ $b = -0.36, p = .837$	No-effect mediation

Note. The confidence interval for the indirect effect is a BCa bootstrapped CI based on 5000 samples.

4.4.3.15. Summary of mediation analysis.

Of the six performed mediation analyses, indirect-only mediation was identified in three instances, which, as described by Zhao et al. (2010), means that an indirect effect ($a \times b$) was identified and that no direct effect (c') was identified. The indirect-only mediation was identified when testing the group study condition with SSQS as the predictor and in both instances when testing the solo study condition (with SSQN and SSQS as predictors). The remaining three mediation analyses identified no-effect mediation, which occurs when neither an indirect nor a direct effect is identified.

Hypothesis H₆ stated that self-efficacy would mediate the effect of social support on perceived stress, which is supported by the three identified instances of indirect-only mediation. To provide further information significant effects will be described to determine the direction of the relationship(s) between predictor, mediator, and outcome, starting with the instances of indirect-only mediation.

With SSQS as the predictor in the group study condition the indirect effect was negative suggesting that as the quantity of social support (SSQS) increased perceived stress decreased. Significant *a* (positive) and *b* (negative) pathways occurred, suggesting that as SSQS increased as did self-efficacy and that as self-efficacy increased, perceived stress decreased.

For the solo study condition, both indirect effects were negative suggesting that as the quantity of social support (SSQN and SSQS) increased, perceived stress decreased. Furthermore, with SSQN as the predictor the *a* and *b* pathways were negative, suggesting that as SSQN increased, self-efficacy decreased and that as self-efficacy increased, perceived stress decreased. With SSQS as the predictor however, despite the indirect effect being significant, resulting in indirect-only mediation, only the *a* pathway was significant (the *b* pathway was non-significant) suggesting that as SSQS increased as did self-efficacy (due to the pathway being positive).

When testing the group study condition with SSQN as the predictor the *b* pathway was significant and negative suggesting that as self-efficacy increased, perceived stress decreased. No-effect mediation occurred when either SSQN or SSQS was the predictor when testing the control study condition however, in both instances the *b* pathway was significant and negative suggesting that as self-efficacy increased, perceived stress decreased.

Consequently, the detection of indirect-only mediation does suggest that there may be a relationship between social support and perceived stress that is mediated by self-efficacy thereby, providing support for H_6 leading to it being accepted.

4.4.4. Summary of results and hypotheses.

Based on the provided evidence, of the seven hypotheses that were proposed one has been accepted and six have been rejected. See Tables 4.20–4.22 for specific information regarding the acceptance/rejection of hypotheses, which are supported by their respective qualitative mechanistic and clinical inferences where relevant.

Study 2's discussion (Section 4.5.) will contain further examination of these findings as well as a consideration of their implications. Furthermore, the present study's design and method will be evaluated as well.

Table 4.20

Summary of Study 2 hypotheses - part 1; H_{4a-c} (NHST test: 3×2 mixed ANOVA, group vs solo study condition comparisons)

Hypotheses	Accept / reject Hypothesis	Outcome measure	Statistical Significance	Magnitude-based inferences	
				Mechanistic inference	Clinical inference
H_{4a} : Group activity increases social support over time more than solo activity does	Reject	SSQN	Significant	Likely negative	Don't use
		SSQS	Non-significant	Unclear	Don't use
H_{4b} : Group activity increases self-efficacy over time more than solo activity does	Reject	GSES	Non-significant	Unclear	Don't use
H_{4c} : Group activity decreases perceived stress over time more than solo activity does	Reject	PSS	Non-significant	Unclear	Don't use

Note. SSQN = Social Support Questionnaire number score; SSQS = Social Support Questionnaire Satisfaction score; GSES = General Self-Efficacy Scale; PSS = Perceived Stress Scale.

Table 4.21

Summary of Study 2 hypotheses - part 2: H_{5a-c} (NHST test: ANCOVA, group vs solo and solo vs control study condition comparisons)

Hypotheses	Accept / reject Hypothesis	Outcome measure	Statistical Significance	Magnitude-based inferences	
				Mechanistic inference	Clinical inference
H_{5a} Computer game play produces greater levels of social support when compared to no computer game play, but only when the computer game play is sociable.	Reject	SSQN	Significant	Likely positive	Use
		SSQS	Non-significant	Likely trivial	Don't use
H_{5b} Computer game play produces greater levels of self-efficacy when compared to no computer game play, but only when the computer game play is sociable.	Reject	GSES	Non-significant	Very likely trivial	Don't use
H_{5c} Computer game play produces lower levels of perceived stress when compared to no computer game play, but only when the computer game play is sociable.	Reject	PSS	Non-significant	Likely negative	Don't use

Note. SSQN = Social Support Questionnaire number score; SSQS = Social Support Questionnaire satisfaction score; GSES = General Self-Efficacy Scale; PSS = Perceived Stress Scale.

Table 4.22

Summary of Study 2 hypotheses - part 3: H₆ (Mediation analysis)

Hypothesis	Accept / reject H _#	Condition (and predictor)	Interpretation of mediation (Zhao et al., 2010)
H ₆ : Self-efficacy mediates the effect of social support on perceived stress.	Accept	Group (SSQN)	No-effect mediation
		Group (SSQS)	Indirect-only mediation
		Solo (SSQN)	Indirect-only mediation
		Solo (SSQS)	Indirect-only mediation
		Control (SSQN)	No-effect mediation
		Control (SSQS)	No-effect mediation

Note. SSQN = Social Support Questionnaire number score; SSQS = Social Support Questionnaire satisfaction score; GSES = General Self-Efficacy Scale; PSS = Perceived Stress Scale.

4.5. Discussion - Study 2

Similar to the structure of Study 1's discussion section, the discussion section of Study 2 involves a number of subheadings to facilitate a logical process of evaluation that is specific to Study 2. This includes commentary of Study 2's design, method, and analytical strategy, as well as a discussion of the study's findings and their significance in relation to the broader psychological literature. Following an evaluation of the present study, consideration is made regarding the original contribution to knowledge that has been made by the study. Additionally, potential directions of inquiry that have been made possible by this research are considered.

4.5.1. Discussion of design, method, and analysis.

Evaluation of the study's design, method, and analytical techniques is presented within this subsection. The purpose of this is to determine if the described findings of the study are attributable to the intervention and, therefore, the performed experimental manipulation or if confounding variables, for example, may be more explanative of the findings instead.

4.5.1.1. Design.

Similarly to Study 1, it was necessary to postpone study participation during breaks in university semesters, for example, in which participants typically moved to out-of-semester accommodation. It is unclear as to what impact this may have had upon the collected data, as exposure to sources of social support and stressors may have differed between participants, depending upon their individual environments during such times.

One of the limitations that were highlighted in the process of evaluating Study 1 was that of sample size. As a product of the extensive data-screening process a number of cases were, appropriately, expunged from the data set, resulting in a net sample size smaller than that derived from prospective power analysis. The anticipation that cases may be identified for removal from the data set following data screening was considered to be a possibility during the data collection process of Study 2. As such, a larger sample than what was recommended by prospective power analysis ($N = 63$, $n = 21$) was recruited with a total sample size of $N = 89$ involving 33, 23, and 33 participants recruited into the group, solo, and control study conditions, respectively. Following the evaluation of Study 1's design, it was decided that from the onset of data collection individuals recruited into the group study condition of Study 2 would be able to participate in 'teams' consisting of between two to four individuals. This change resulted in the successful and timely recruitment of participants into the group study condition.

4.5.1.2. Method.

Another limitation that was identified through the evaluation of Study 1 was that of cases being detected after data collection that violated inclusion and/or exclusion criteria or had potentially recorded erroneous information. Study 2 did not utilise as restrictive participation criteria as Study 1 did, except that participants must be over the age of 18 to participate. Consequently, regular checks of collected data were carried out at each measurement point in order to identify instances of erroneous/impossible values being recorded or missing values occurring. This method appears to have been effective in its purpose as no missing or erroneous data values were detected during the data-screening process and, as such, the collected data was retained for analysis.

The effect of potential confounding variables was controlled in Study 2 due to the consistent use of a single laboratory space. Therefore, each participant was exposed to the same environment, including ambient temperature, lighting, and physical space. The decision to conduct the experiment in a constant environment should bolster the validity and reliability of the study.

The GSES was modified to include two reverse-scored items and the PSS was designed to include seven reverse-scored items. The inclusion of reverse-scored items can be beneficial in identifying instances of participant fatigue/boredom, acquiescence, and extreme response bias, and, therefore, help to contribute to the validity of a measure. The SSQ6 was not modified to include any reverse-scored items because it would be inappropriate to do so due to the specific format of its items, as explained in Section 3.5.1.2.

Recruitment of participants during Study 1 occurred over a period of time that was longer than initially expected. In response to this, it was decided that a participation incentive would be offered to encourage recruitment and participation within Study 2. The incentive took the form of a prize draw with three prizes consisting of Amazon vouchers of £50, £25, and £10 for the first, second, and third prizes, respectively. Permission to include this prize draw was submitted to Teesside University's research ethics committee and was approved.

Information describing the Amazon voucher prize draw was made available to prospective participants who saw the present investigation on Teesside University's online research participation system. Furthermore, the researcher informed participants about the prize draw during initial recruitment to the study. In addition, it is conceivable that information regarding the prize draw occurred through word-of-mouth. The prize draw occurred at the conclusion of data

collection and winners were selected at random by an online random number generator who were then contacted via email.

There are ethical considerations that need to be made when implementing a prize draw such as the one used within the present study. The concern with offering incentives for participation in research is that the rights of participants should be maintained, such as that of voluntary participation and the right to withdraw from the study at any time without consequence. As such, entry into the present study's prize draw was not made conditional upon completion of the eight week intervention, which was explained to participants. Entry into a prize draw regardless of withdrawal from participation is essential as there are implications of interference with a participant's decision to withdraw from research if they are then denied entry into a prize draw as a result of their study withdrawal.

4.5.1.3. Analysis.

4.5.1.3.1. Data screening.

A rigorous data screening process was carried out, using similar techniques that were used in Study 1's data screening process and described in Section 4.4.2. The data screening process involved inspection of the data set using histograms, box plots, standardised residuals, and Cook's distance values, interpretation of which were informed through the statistical literature (Bollen & Jackman, 1990; Field, 2016, 2017). Following the data-screening process, no cases were identified for removal from the data set and; as such, the sample size that was retained for inferential analysis was $N = 89$.

4.5.1.3.2. *Reliability analysis.*

The measures that were used within the study, the SSQ6, GSES, and PSS are each well-established within the psychological literature and have been found to be reliable. Within this thesis the SSQ6 has previously been identified as a reliable measure from previous literature (Sections 3.3.3.1. and 3.5.1.3.2.). The conducted internal reliability analysis using the present study's data confirmed this to be the case as well, with values being considered to be between good and excellent for the SSQN factor (between $\alpha = .88$ and $\alpha = .94$) and for the SSQS factor (between $\alpha = .89$ and $\alpha = .95$). The authors of the GSES and PSS both indicate that these measures possess internal consistency values ranging from acceptable to good with values between $\alpha = .76$ and $\alpha = .90$, in the case of the GSES (Schwarzer & Jerusalem, 1995) and values between $\alpha = .84$ and $\alpha = .86$ in the case of the PSS (Cohen et al., 1983). Within the present study, internal consistency values were found to be similar to those provided by the measure authors with values ranging from acceptable to good, $\alpha = .72$ to $\alpha = .88$ and $\alpha = .79$ to $\alpha = .89$, for the GSES and PSS, respectively.

4.5.1.3.3. *Inferential analysis.*

As a similar design was used to that of Study 1. The analytical techniques that were applied in the present study were identical, that of 3×2 mixed ANOVA, ANCOVA, and mediation analysis. Each test was applied in order to test the hypotheses of the study. The supplemental application of MBI and Zhao et al.'s (2010) typology of mediations and non-mediations supported the performed inferential analyses and provided additional credibility to the interpretation of findings.

Hypotheses H_{4a}-H_{4c} stated that group activity increases social support and self-efficacy, and decreases perceived stress over time more so than solo activity. As such, this involved testing for both an independent measure, group study condition against solo study condition, and a repeated measure, baseline against week eight. Therefore, mixed ANOVA was an appropriate choice of inferential test and was used to test for any difference in changes as a function of treatment through the main effect as well as testing for an interaction effect between treatment and time.

Hypotheses H_{5a}-H_{5c} stated that computer game play would produce greater levels of social support and self-efficacy and lower levels of perceived stress when compared to no computer game play, but only when the computer game play is sociable. ANCOVA was used to test hypotheses H_{5a}-H_{5c} because it facilitated the ability to observe the impact of the study's intervention on participants whilst holding constant and, thereby, removing the influence of the initial outcome variable measurements. Therefore, ANCOVA was an appropriate choice of inferential test to observe the efficacy of the study's intervention where it was used to test the effect of the sociable computer game play treatment against that of solo computer game play and no computer game play. MBIs were applied to both 3×2 mixed ANOVA and ANCOVA simple comparisons to produce additional information beyond that which these tests typically can provide as described in Sections 3.4.3.1. and 3.5.1.3.3.

In order to test hypothesis H₆, which stated that self-efficacy mediates the effect of social support on perceived stress, a series of mediation analyses was performed using modern techniques informed through literature (Field, 2017; Hayes, 2018; MacKinnon, 2008). The interpretation of the mediation analysis findings was

supplemented using Zhao et al.'s (2010) typology and mediations and non-mediations, which was effective in establishing when mediation can be said to have occurred or, alternatively, not to have occurred.

4.5.2. Discussion of findings.

This section includes an initial summary of the inferential analyses findings, which is followed by the application of the findings to the wider psychological literature. A statement of Study 2's unique contribution(s) to knowledge is also made.

4.5.2.1. Summary.

4.5.2.1.1. 3×2 Mixed ANOVA.

Mixed ANOVA was used to determine if social support (H_{4a}) and self-efficacy (H_{4b}) increased, and if perceived stress (H_{4c}) decreased in the group study condition over time when compared to the solo study condition.

A significant difference was detected between the group and solo study conditions with SSQN as the dependent variable. However, the difference was in an unexpected direction suggesting that SSQN scores were lower in the group study condition when compared to the solo study condition, and not higher as H_{4a} stated. No other significant differences were detected between the group and solo study conditions, which is inconsistent with the statements made by hypotheses H_{4b} and H_{4c} .

The associated MBIs revealed a likely negative mechanistic inference with SSQN as the dependent variable. When SSQS, GSES, and PSS outcomes were the dependent variable their respective mechanistic inferences were unclear. None of the 3×2 mixed ANOVA clinical inferences recommended use of the intervention.

Following the recommendations of Hopkins et al. (2009), van Schaik and Weston (2016), and Weston et al. (2014), Table 4.23 presents the unclear inferences from 3×2 mixed ANOVA alongside qualitative descriptors defining the likely range of each effect based upon the upper and lower ends of each confidence interval. Qualitative descriptors are informed by Hopkins' (2002) scale of magnitudes for effect statistics, which associates appropriate descriptors to specific ranges of values. The following descriptors are associated with specific ranges of values from odds ratio, trivial (± 1 to ± 1.5), small (± 1.5 to ± 3.5), moderate (± 3.5 to ± 9), large (± 9 to ± 32), very large (± 32 to ± 360), nearly perfect ($> \pm 360$), and perfect (infinite).

Table 4.23

Unclear inferences from 3×2 mixed ANOVA including the value of effect statistics, ±90% confidence limit, lower and upper limits with associated mechanistic inference qualitative descriptors.

Outcome	Value of effect statistic (mean difference)	±90% CL	Likely range of the effect		Qualitative description
			Lower limit	Upper limit	
SSQS	0.01	0.32	-0.31	0.33	At most a below trivial positive or a below trivial negative effect.
GSES	0.41	2.07	-1.66	2.48	At most a small positive or a small negative effect.
PSS	-0.57	3.70	-4.27	3.13	At most a small positive or a moderate negative effect.

Note. SSQS = Social Support Questionnaire Satisfaction score; GSES = Generalized Self-Efficacy Scale; PSS = Perceived Stress Scale; CL = confidence limit; to calculate the likely range of the effect deduct ±90% CL from value of effect statistic for lower limit and sum for upper limit.

Given the associated qualitative descriptors for the three unclear inferences from 3×2 mixed ANOVA it can be seen, in the cases of the SSQS and GSES outcomes that the true effect is likely to be either positive or negative. In the case of the PSS outcome, the true effect appears to be more likely to be harmful than beneficial.

4.5.2.1.2. ANCOVA.

Whilst initial outcome scores (the covariates) were held constant, ANCOVA was used to determine if sociable computer game play in particular, rather than computer game play in general, facilitated greater levels of social support (H_{5a}) and self-efficacy (H_{5b}) and lower levels of perceived stress (H_{5c}). As such, this necessitated the comparison of the group study condition with the solo study condition as well as comparison between the solo and control study conditions.

ANCOVA revealed that each covariate (initial measurement) significantly influenced their associated week eight outcome variable. All other experimental effects were non-significant, other than both of the comparisons with SSQN as the dependent variable, which compared the group and solo study conditions and the solo and control study conditions, respectively. These significant effects suggest that SSQN scores between the solo and control study conditions were different, which is inconsistent with H_{5a} and, despite identifying that SSQN scores differed between the group and solo study conditions, the difference between the group and solo study conditions was not in the stated direction and therefore inconsistent with H_{5a} .

When comparing the group and solo study conditions, mechanistic inference indicated that the intervention was likely to be negative with SSQN as the dependent variable and most likely to be trivial with SSQS as the dependent

variable. These inferences provide some evidence to suggest that the intervention potentially influenced the measured elements of social support differently. Two instances of unclear inferences were made when comparing the group and solo study conditions with GSES and PSS as the dependent variable. Table 4.24 presents the unclear inferences alongside associated qualitative descriptors, as appropriate, to define the likely range of each effect based upon the upper and lower ends of each confidence interval (Hopkins, 2002; Hopkins et al., 2009; van Schaik & Weston, 2016; Weston et al., 2014).

Table 4.24

Unclear inferences from ANCOVA comparing the group and solo study conditions including the value of effect statistic, $\pm 90\%$ confidence limit, lower and upper limits with associated mechanistic inference qualitative descriptors.

Outcome	Value of effect statistic (mean difference)	$\pm 90\%$ CL	Likely range of the effect		Qualitative description
			Lower limit	Upper limit	
GSES	0.41	1.45	-1.04	1.85	At most a small positive or a trivial negative effect.
PSS	0.57	7.11	-6.54	7.68	At most a moderate positive or a moderate negative effect.

Note. GSES = Generalized Self-Efficacy Scale; PSS = Perceived Stress Scale; CL = confidence limit; to calculate the likely range of the effect deduct $\pm 90\%$ CL from value of effect statistic for lower limit and sum for upper limit.

The associated qualitative descriptions of the two unclear inferences from ANCOVA do not indicate any instances where the true effect is substantially more likely to be positive than negative. In the case of the unclear inference with PSS as the dependent variable, the likely range of the true effect was considered more likely to be negative than positive. As such, it appears that both unclear inferences do not support the expected findings of this study.

When comparing the solo and control study conditions inferences of likely positive and likely negative were made with SSQN and PSS as the dependent variable, respectively. Trivial inferences were made with SSQS (likely) and GSES (very likely) as the dependent variable. The performed MBIs comparing the solo and control study conditions provide some evidence to suggest that they differed in SSQN and PSS scores, which is inconsistent with the expectations of the study's findings.

4.5.2.1.3. Mediation analysis.

Mediation analysis was performed in order to determine if perceived stress was influenced by social support, and this effect was mediated by self-efficacy (H_6). Using Zhao et al.'s (2010) typology of mediations and non-mediations to evaluate each mediation analysis, three instances of indirect-only mediation were identified. These occurred in the group and solo study conditions with the SSQS factor of the SSQ6 as the predictor and with the SSQN factor of the SSQ6 as the predictor in the solo study condition. Due to the occurrence of indirect-only mediation, mediation can be said to have occurred and provides evidence for H_6 . All other mediation analyses were evaluated as having no-effect mediation, suggesting that mediation had not occurred in those instances.

4.5.2.2. Application of findings to literature.

The present investigation aimed to use sociable computer game play in order to reduce perceived stress in participants. Here the findings of the study are applied to the broader psychological literature. A more comprehensive discussion and application of Study 2's findings the theoretical framework of the thesis is presented within the general discussion (Chapter 6).

A lack of social support, whether from social isolation or insufficient social support provided by social relationships, appears to be a prominent factor in the perception of stress. Furthermore, the perception of stress is implicated with the occurrence of physiological ill-health. This association between social support, perceived stress, and physiological ill-health is recognised within the psychological literature (Anjara et al., 2017; Cacioppo et al., 2000; Hawkley & Cacioppo, 2007; Hawkley et al., 2003; Hawkley et al., 2008; Jou & Fukada, 2002; Lauder et al., 2006; León-Pérez et al., 2016; Schwarzer et al., 1994; Segrin & Passalacqua, 2010). As such, the potential effect of improving the social support of individuals has far-reaching implications in terms of reducing the perception of stress and thereby reducing the occurrence of illness. The findings of the present study are mixed in terms of their congruence with the identified association(s) between social support and perceived stress.

The occurrence of indirect-only mediation provides evidence that builds on the work of Segrin and Passalacqua (2010) as well as Hawkley and Cacioppo (2007). Segrin and Passalacqua (2010) identified a relationship between social support and general health, which was mediated by loneliness (an absence of social support); as social support decreases, loneliness increases leading to poor

general health. An association was established between loneliness and general health, which was mediated by perceived stress; as loneliness increases perceived stress increases, leading to a reduction in general health. Hawkley and Cacioppo's (2007) research describes the association between loneliness and health by drawing evidence from a series of studies. They established that loneliness is associated with increased BMI, physical inactivity, and smoking (Lauder et al., 2006); lonely individuals experience a greater frequency of stressors (Hawkley & Cacioppo, 2007; Hawkley et al., 2008); lonely individuals are more likely to report activities to be more stressful and to have a reduced capability in meeting challenges (Hawkley et al., 2003; Hawkley et al., 2008); and loneliness typically is inversely associated with active coping such as seeking support (Cacioppo, et al., 2000; Hawkley et al., 2008).

A reduced capability to rise to challenges as well as choosing to be inactive in coping may be indicative of reduced self-efficacy, which was not measured within Hawkley and Caccioppo's (2007) work. The mediation relationship that was identified within the present study suggests that as social support increases, so too does self-efficacy, which in turn decreases perceived stress. Applying the present study's findings to those of Segrin and Passalacqua (2010) and Hawkley and Cacioppo's (2007) could be achieved by including self-efficacy to produce a model such as the one depicted in Figure 4.8., which may be more accurate in explaining the association between an absence of social support (loneliness) and general health identified within the psychological literature.

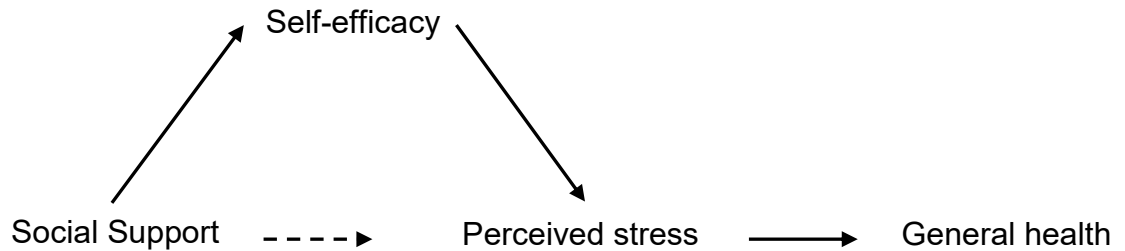


Figure 4.8. Theorised mediation model describing an association between social support and perceived stress, mediated by self-efficacy, which is associated with general health.

The findings from the present study cannot be used to comment on the association between perceived stress and general health. In order to test this model further research would need to be conducted, in which, measure(s) of general health are incorporated into the method. Conducting such research would provide the opportunity to demonstrate the mechanism(s) between social support and perceived stress, mediated by self-efficacy, as well as the effect of perceived stress on general health.

It was stated that exposure to sociable computer game play, rather than computer game play in general, would elicit changes in social support, self-efficacy, and perceived stress. The similarity in the outcome measures SSQN, SSQS, GSES, and PSS between the solo and control study conditions was expected due to the previously identified prominent motivation for computer game play to engage in sociable computer game play (Cole & Griffiths, 2007; Jansz & Tanis, 2007; Longman et al., 2009; Park et al., 2011; Reinecke, 2009b; Westwood & Griffiths, 2010; Williams et al., 2006; Williams et al., 2008; Yee, 2006a, 2006b). As such, engaging in non-sociable computer game play would not provide the opportunity for individuals to derive any beneficial effect that typically sociable computer game play might offer, such as social support, as outlined in Iwasaki and Mannell's (2000) hierarchical model of leisure stress coping within the leisure friendships sub-dimension.

A number of hypotheses that were made were not supported. It was stated that group activity would increase social support (H_{4a}), self-efficacy (H_{4b}), and reduce perceived stress (H_{4c}) over time more so than solo activity, which was found not to be the case. It was also stated that specifically sociable computer game play, rather than computer game play in general, would produce greater levels of social support (H_{5a}), self-efficacy (H_{5b}), and lower levels of perceived stress (H_{5c}), which was also found not to be the case. The assessment of these hypotheses as being unsupported was due either to non-significance of 3×2 mixed ANOVA and ANCOVA, or, in the case of the two occurrences of statistical significance being in the wrong direction. MBIs did not provide supplementary information to suggest that an effect had occurred within the stated direction.

A potentially prominent factor in why the unexpected findings might have occurred is that of the student population from which participants were recruited into the present study. Stallman (2010) compared the prevalence of mental health problems and psychological distress in a sample of 6,479 university students, recruited from two Australian universities, with the general population. The purpose of this study was to provide epidemiological data in order to benchmark the properties of university students with that of the general population.

Psychological distress was measured using the Kessler psychological distress scale (K10; Kessler et al., 2003) which is a widely used tool designed to identify levels of distress. The K10 ranges from scores of 10 to 50, with scores above 30 being indicative of high levels of psychological distress. The university students reported statistically significantly higher levels of psychological distress when compared with the general population, with 19.2% of students measuring at high levels of distress compared to 3% of the general population. Furthermore,

academic achievement was inversely associated with increasing psychological distress, suggesting that as psychological distress increases academic achievement decreases. According to Stallman (2010), this could produce a perpetual effect of distress, leading to poor academic performance, and in turn, leading to further distress.

Evidence which supports Stallman's (2010) findings suggest that, as a population, university students are prominently more stressed than the general population is that of Durand-Bush, McNeill, Harding, and Dobransky (2015). It was identified, in a series of two studies, that Canadian undergraduate students exhibit consistent moderate-to-high levels of stress as well as poor mental health. In addition to the above findings pertaining to Australian and Canadian university students, McIntyre, Worsley, Corcoran, Harrison Woods, and Bentall (2018) investigated UK university students and predictors of student psychological distress. Loneliness was identified as the most prominent overall predictor of psychological distress, whereas assessment stress was found to be the strongest academic predictor of psychological stress.

As such, the psychological literature suggests that the university student population is consistently exposed to levels of psychological stress typically greater than that of the general population. This heightened perception of stress may be attributable to assessments and other course-related stressors or, potentially, social stressors due to university enrolment often entailing novel social situations, such as living arrangements and loneliness. This is possibly explanative of the findings which were unsupportive of hypotheses within the present study, due to the potentially heightened levels of psychological stress that university students have been found to be exposed to (Durand-Bush et al., 2015; McIntyre et

al., 2018; Stallman, 2010). Increasing the amount of time participants engaged in sociable computer game play may have been necessary to overcome the heightened perception of stress that participants, as university students, were likely to be experiencing. This could be achieved by increasing the frequency of laboratory sessions, increasing the duration of computer game interaction, and/or conducting the intervention over a greater period of time than eight weeks. Care, however, must be taken that in doing so that participant fatigue or boredom is avoided.

A further explanative factor as to why the unexpected findings occurred is that of the leisure activity used within the present study. As Bedini et al. (2017) identified, for leisure to provide therapeutic benefits to perceptions of stress and consequently health, the leisure activity needs to be meaningful to the individual. This suggests that the freedom to pursue particular leisure experiences is essential for leisure to provide therapeutic benefits to stress perception. This is described as leisure autonomy in Iwasaki and Mannell's (2000) hierarchical model of leisure stress coping. Leisure autonomy was consciously included within the design of the present study by way of providing participants the opportunity to choose which activity available in the Wii Sports computer game suite between tennis, bowling, and golf that they wanted to engage in. However, it is possible that the choice between three activities was too limiting and that in some cases none of the options may have been particularly meaningful or enjoyable to some participants. A limitation of providing participant choice in computer game activity is the loss of experimental control due to potential differences in activity choice and the confounding effect this may have on measured outcomes, this is discussed further within the general discussion (Chapter 6).

4.5.3. Study 2's unique contribution to knowledge.

Study 2 shares many of the unique contributions to knowledge that were established in Study 1. This was intentional by design, as the present thesis aimed to investigate the capacity for sociable computer game play to elicit social support and self-efficacy, and, in turn, to investigate sociable computer game play as a beneficial tool for a range of health outcomes. As such, similar methods and procedures were utilised within the present study as were used in Study 1 to ensure that any outcome could be attributable to the intervention that was used rather than potential changes between the two studies.

Therefore, a brief account of the unique contributions to knowledge made by Study 2, which were also made by Study 1, is included here. The design of the conducted experiment involving the three study conditions group, solo, and control has made it possible to identify if sociable computer game play, rather than computer game play in general produces a positive effect to social support, self-efficacy, or perceived stress. Additionally, the analytical techniques that were used within the present study, especially those of MBI are under-used within the psychological literature and provide many unique benefits (as outlined in Sections 3.4.3.1. and 4.4.3.1.) when used in conjunction with more typical NHST.

Similarly as was the case in Study 1, the supplementation of MBI within the present study using planned comparisons from both 3×2 mixed ANOVA and ANCOVA provided additional rich information that would not have been available from the respective NHST testing alone. Examples of this include following 3×2 mixed ANOVA and ANCOVA, MBI inferred the group study condition to be mechanistically likely negative and clinically likely harmful and most unlikely

beneficial. Following ANCOVA, the SSQS outcome was inferred to be most likely trivial and clinically most unlikely beneficial or harmful. Inferences for the outcomes GSES and PSS were unclear, in applying appropriate qualitative descriptors to these unclear inferences (Table 4.25) the GSES outcome was described as having at most a small positive or a trivial negative effect and the PSS outcome was described as having at most a moderate positive or a moderate negative effect. In investigating the unclear mechanistic inferences further between the group and solo study conditions following ANCOVA, noteworthy information was identified indicating the potential presence of an effect for the GSES and PSS outcomes that were not clearly attributable as either positive or negative. Without the supplementation of MBI within Study 2 the extent of information provided by the analytical strategy that was used would have been limited to the identification and reporting of statistically significant or non-significant effects.

Iwasaki and Mannell's (2000) hierarchical model of leisure stress coping was applied in a similar fashion as it was in Study 1 as a theoretical basis to justify why sociable computer game play may be facilitative of social support as well as supporting the initial pathway which predicts an increase in social support within the proposed model of mediation (Figures 2.12. and 4.1.). This unique application of the model was successful as indirect-only mediation was identified to have occurred with satisfaction with social support (SSQS) in the group and solo study conditions and the amount of received support (SSQN) in the solo study condition. This provides original evidence to support the postulation that social support, which has been derived from sociable computer game play, can be effective in facilitating a reduction in perceived stress through a relationship that is mediated by self-efficacy. Further discussion of the original application of Iwasaki and

Mannell's (2010) hierarchical model of leisure stress coping in relation to the present study and Study 1 is presented within the general discussion (Chapter 6).

The present study provides a unique investigation into the role that leisure (sociable computer game play) can have in reducing perceived stress. The study achieved this through a combination of a novel application of theory, which supported the novel arrangement of psycho-social constructs that were tested within this investigation. The original contributions to knowledge made by the present study provide evidence to suggest that sociable computer game play can be used to facilitate positive health-related behaviour change in terms of reducing perceived stress. This research builds upon the novel contributions that were made in Study 1 by establishing the potential of this technology to facilitate positive health-related behaviour change across a range of behavioural outcomes. This is valuable due to the aforementioned prevalence of computer games within the UK and their relative affordability making the technology an ideal tool for use in positive health-related behavioural intervention programmes.

4.5.4. Future avenues of inquiry.

There are a number of appropriate avenues available for potential future inquiry that stem from the present investigation and may contribute further knowledge on the capability of sociable computer game play in facilitating social support, self-efficacy, and reducing perceived stress. The primary avenue is that of improving the design and method of the study to better establish if sociable computer game play can facilitate suitable social support in order to reduce perceived stress. As identified, it is possible that the activity selection within the present study was insufficient to provide participants with a sense of leisure autonomy and, as such,

future studies could provide participants with a broader range of sociable computer game options so that the chosen leisure activity is more likely to be meaningful to the participant(s). There are two problems that could arise from providing more choice to participants. Firstly, is that choice creates a lack of experimental control and therefore increases error variance as well as reducing statistical power.

Secondly, is that of differences in preference for group study condition participants, this is because participants within this study condition will need to mutually agree on which activity to engage in thereby potentially denying the opportunity for autonomy in some of the participants. This was potentially the case in the present study with group study condition participants choosing between tennis, bowling, and golf; however, with more options there is a greater probability of disagreement occurring.

In order to investigate the potential model that was presented in Figure 4.8., measure(s) of general health would need to be used so that associations between social support, self-efficacy, perceived stress, and general health can be investigated within a single study. An example of a potentially appropriate measure of general health would be the Medical Outcome Study Short Form 36 health survey (MOS SF-36; Ware & Sherbourne, 1992). This has been extensively used throughout the health sciences and includes scales to measure physical functioning, general health perceptions, and mental health as well as other constructs.

Chapter 5 – Study 3 Qualitative evidence

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5.1. Overview - Study 3

The purpose of this chapter is to explore, using qualitative methods, how sociable computer game play might facilitate positive health-related behaviour change. The purpose of including qualitative data within this thesis is to qualify and further explore the identified associations between the psycho-social elements that were presented within the research model that is central to this thesis (see Figures 2.12., 3.1., and 4.1.). More specifically, the evidence presented within this chapter aims to qualitatively explore the role of sociable computer game play in facilitating social support, and the association between social support, self-efficacy, and perceived stress.

As such, the experimental protocol from Study 2 was repeated with a small number of participants over a three week period. Qualitative data were collected following computer game play at each measurement point using focus groups, in the case of the group study condition, and semi-structured interviews, in the case of the solo study condition. Information pertaining to this study, referred to as Study 3, as well as the collected data and analyses are presented within this chapter.

5.2. Method - Study 3

5.2.1. Design.

The quantitative aspects of Study 3 involved an experimental independent measures design with random allocation to the study conditions. The independent variable was study condition and included two levels: group and solo. Dependent variables were: (1) social support, (2) self-efficacy, and (3) perceived stress.

The primary interests of Study 3 however revolve around methods of qualitative research and analysis. As outlined in Mack, Woodsong, MacQueen, Guest, and Namey (2005) qualitative research methods provide a plethora of benefits that which quantitative methods do not. A particular strength of the qualitative approach is its capacity to illuminate how individuals uniquely experience a particular research context by exploring factors such as opinions, emotions, and inter-personal relationships (Gough & Deatrck, 2015). Qualitative research methods differ most notably in terms of their flexibility in comparison to the typically rigid nature of quantitative approaches (Mack et al., 2005). The advantage of this is that it provides the researcher an opportunity to adapt to new information by tailoring subsequent questions to further explore ideas or opinions expressed by the participant that are of interest to the researcher (Clarke, Braun, & Hayfield, 2015).

Using qualitative research methods in Study 3 benefits the thesis as a whole by providing the opportunity to better understand the complex intricacies of the thesis' research area. This information, in conjunction with the quantitative data reported in Studies 1 and 2, should paint a more full and holistic account of the role that sociable computer game play may have in facilitating positive health-related behaviour change. Furthermore, with the inclusion of both quantitative and qualitative research methods within the present thesis, the presented evidence as a whole takes advantage of the strengths that are implicit to each method whilst also minimising the weaknesses that are systemic to each perspective (Greene, 2007).

Within the context of the present study, it is expected that the adoption of qualitative research methods will provide participants with an opportunity to

express their own contextual points of view regarding their computer game play and general experiences from participating within the research. In doing so, participant's beliefs regarding the effect of computer game play upon social support, self-efficacy, and perceived stress, following computer game play, may be recorded and analysed in a richer fashion than that offered by the SSQ6, GSES, and PSS.

The particular methods of qualitative data collection used within Study 3 involved focus groups and semi-structured interviews. Qualitative data collection occurred following each computer game play session over a three week intervention period. The decision to collect qualitative data following computer game play across three sequential weeks was informed following the rationale behind the performing of mediation analyses in Study 1 and 2 using data from sequential weeks. In which it is logical to assume that any changes experienced in social support would be seen to impact self-efficacy at the subsequent measurement point, and so-on for perceived stress (being affected by changes in self-efficacy).

In the case of the solo study condition, qualitative data collection involved the use of semi-structured interviews whereas the group-study condition involved the use of focus groups for qualitative data collection. This difference in the methods that were used stems simply from the number of participants involved during each computer game play session. Solo study condition participants took part in the intervention on an individual basis whereas group study condition participants took participated socially and, as such, methods of qualitative data collection were used that reflected this discrepancy. For example, group study condition participants were able to discuss their shared experiences and thoughts regarding their sociable computer game play within a focus group format whereas, a semi-

structured interview format was sufficient for eliciting the individual experiences and opinions of solo study condition participants. Both of these qualitative data collection methods have their own distinct advantages and applications in research as highlighted by Mack et al. (2005). Semi-structured interviews provide the opportunity to explore an individual's interpretations of phenomena and the world as well as their personal opinions and feelings of their experiences, in which perceived causal relationships between factors can also be explored. This is not to say that focus groups are precluded from collecting individualistic data as well, however the advantage of focus groups is their ability to produce a large amount of information from a broad range of views on a specific topic. This provides an opportunity to explore areas where commonalities or disagreements occur within a specific population, which in this case is the group study condition.

The focus groups and semi-structured interviews were designed to record participants' experiences as well as their thoughts and feelings regarding their solo computer game play or sociable computer game play. This was done so as a form of concept elicitation in order to investigate if participants could express concepts, without direct prompting, pertaining to those investigated within the research model (Figure 2.12). Specifically, this involved interest around the following concepts; firstly, examining whether participants experienced social support following sociable computer game play, secondly if any social support following sociable computer game play facilitated a sense of self-efficacy, and thirdly a reduction in perceived stress as a mediated effect of self-efficacy from social support following sociable computer game play.

As such, the purpose of the qualitative research methods and associated findings that are described within this chapter is to complement the reported quantitative

findings of Studies 1 and 2 by exploring further the capacity for sociable computer game play to be facilitative of positive health-related behaviour change, potentially by facilitating social support and self-efficacy. Specific information pertaining to the performed qualitative analysis (thematic analysis) is presented in Section 5.2.5.

5.2.2. Participants.

Six individuals were recruited into this study using an opportunistic sampling strategy, prospective participants were required to be over 18 years in age. The sample consisted of five male (83.3%) and one female (16.7%) participants whose ages ranged between 26 and 46 ($M = 32$; $SD = 7.38$). The six participants were allocated, randomly, between the two study conditions (group, $n = 4$; solo, $n = 2$). Similar to Study 1 and 2, the participants allocated to the group study condition participated simultaneously in a single ‘team’. Descriptive statistical information regarding each study condition are displayed in Table 5.1.

Table 5.1

Descriptive statistics of the sample by study condition

Condition	<i>n</i>	Sex		Age		
		<i>Male</i>	<i>Female</i>	<i>Range</i>	<i>Mean</i>	<i>SD</i>
Group	4	4 (100%)	27 (0%)	26–46	32.50	9.15
Solo	2	1 (50%)	1 (50%)	28–34	31.00	4.24

Due to the small scale of the present study as well as the primary interest of collecting qualitative information, the data set was not subject to the rigours data screening process that was outlined in Study 1 and 2. The size of the recruited sample is however acceptable within the context of collecting qualitative data, as explained by Boddy (2016) who posits that within qualitative research sample

sizes are contextual to the research topic and informed by the particular scientific paradigm that is under investigation. As such, it is possible for sample sizes as small as single n case studies to be meaningful and informative. Other factors that can be considered in determining appropriate sample sizes include the scope of the investigation, data quality, and time spent with each participant. Within the present investigation, the data quality was high due to the setting that each semi-structured interview and focus group was conducted in. Distractions and obtrusive sound were minimised and, in addition, the data was also digitally recorded and transcribed for further accuracy. Furthermore, each participant was invited to take part in a semi-structured interview or focus group on three separate occasions, which facilitated frequent participant-researcher interactions. Ultimately, Sandelowski (1995) argues that a suitable sample size is one that facilitates thorough case-oriented analysis and produces original and pertinent information to further understanding of the research topic that is under investigation.

5.2.3. Materials.

The materials used within this study to collect quantitative data were identical to those used in Study 2, see Section 4.3.3. for a detailed description of the purpose of each item. Differences in materials between Studies 2 and 3 include updated deadline dates given for withdrawal of participation and data, which was set at 30th November 2019 and a general data protection regulation statement was also included. The information sheet, which includes these described changes and additions, can be seen in Appendix T.

There were a number of unique materials used within Study 3 for the purposes of qualitative data collection. These were a focus group schedule for the group study

condition (Appendix U) and a semi-structured interview schedule for the solo study condition (Appendix V), which were conducted following the first week of computer game play. These two schedules were developed using the theoretical framework of the present thesis, in which the effects of solo and sociable computer game play had upon social support, self-efficacy and perceived stress were of interest.

Examples of questions from these schedules that were directly pertinent to the theoretical framework include; did socialisation enhance or detract from your computer game play experience? Given the opportunity to play with others, would the computer game have been more/less enjoyable? And, did the computer game play affect your stress levels in any way? Other questions not specifically related to the thesis' theoretical framework were also included with a purpose of eliciting additional general information regarding participant's experiences and opinions of their computer game play, such as; was the computer game enjoyable? And also, how did you find yourself engaging with the computer game today?

Participant's responses to the questions and prompts within the focus group and semi-structured interview schedules informed lines of inquiry and questioning for the subsequent weeks of the intervention. As such, strict pre-determined focus group/interview schedules were not prepared for weeks two or three of the intervention. Instead, following examination of week 1's transcripts questions were devised to build upon comments and views that were expressed by participants for interview/focus group at week 2 and so on for week 3. An example of this process is the identification of competition playing an important role in deriving enjoyment from computer game play for the group study condition during the first focus group, which was explored further in the subsequent focus groups. Appendices W and X contain the questions which group study and solo study condition

participants, respectively, were asked during qualitative data collection in weeks 2 and 3 of the intervention.

5.2.3.1. Measures.

Participants were asked to complete the three measures that were introduced in Study 2 on a weekly basis across the three week duration of the experiment: the SSQ6 (Appendix F), the GSES (appendix P), and the PSS (appendix Q). See Section 4.3.3.1. for a detailed description of the item and response structure of each measure as well as information pertaining to the reliability of each measure.

5.2.3.2. Apparatus.

Participants interacted with the computer game Wii Sports (developed by Nintendo in 2006), which was displayed to participants on a large flat-screen television. See Sections 3.3.3.2. for a brief description of the Wii Sports computer game and the Nintendo Wii computer game console that was used to run the computer game.

5.2.4. Procedure.

This study was granted ethics clearance by Teesside University's research ethics committee. Participants were allocated randomly to the group and solo study conditions. The experimental protocol of this study was identical, with two exceptions, to that carried out in Study 2, see Section 4.3.4.1. The exceptions were that the present study was conducted over a three week period rather than the eight week duration and following each computer game play session, participants were invited to a focus group, group study condition, or a semi-structured interview, solo study condition, which is detailed in Section 5.2.5.

5.2.5. Data analysis.

Due to the small number of participants that were recruited into this study, quantitative data analysis is limited to that of descriptive analysis due to insufficient statistical power for any meaningful inferential analysis to be performed. The primary interest within this study, however, is that of the qualitative analysis that was performed on the collected semi-structured interview and focus group transcripts.

Qualitative data analysis involved thematic analysis, in which Braun and Clarke's (2006) six-phase framework will be utilised, see Table 5.2. The purpose of thematic analysis is to identify patterns or communalities (themes) within a dataset that are noteworthy or important. This technique was selected due to the range of benefits that it offers, for example it is useful in examining differing perspectives between research participants in which similarities and differences, in addition to unexpected data, can be effectively documented (King, 2004). The approach involves a clear and explicit procedure in which the analysis should be carried out. This means that thematic analysis provides an effective structure for the handling of data in which noteworthy features within the data set can be easily identified and coherently summarised (Nowell, Norris, White, & Moules, 2017). Furthermore, and most importantly, unlike other qualitative approaches thematic analysis is not constrained to any particular theoretical perspective or epistemology and can therefore fit within the present thesis where research questions and aims have already been formulated (Maguire & Delahunt, 2017). Due to these reasons, a top-down or theoretical thematic analysis was conducted, which is an approach that is driven by specific research questions and/or the researcher's area of focus. This is

different to a bottom-up approach or inductive thematic analysis, which is an approach that is driven by the data itself (Braun & Clarke, 2006).

Table 5.2

Braun and Clarke's (2006) six-phase thematic analysis framework adapted from Maguire and Delahunt (2017)

Phase	Description
1. Familiarise with the data	Reading and re-reading the transcripts. Become familiar with the data, create notes of early impressions.
2. Generate initial codes	Use notes to begin systematic organisation of data. Production of codes used to collate relevant information together.
3. Search for themes	Identify any communality between codes and collating them together to establish themes within the data.
4. Review themes	Review, modify, and/or develop initial themes ensuring themes are analogous to the coded extracts. Does the data support the themes?
5. Define themes	Final refinement of themes with the aim to elucidate their central meaning. Definitions and names of themes are generated.
6. Write-up	Ensure themes are pertinent to research question(s). Presentation of theme representative samples and the production of an analytical report.

As such, three focus groups and six semi-structured interviews in total were conducted in which the audio content was digitally recorded. Each recording was then transcribed into a transcript, which was then included in a top-down theoretical thematic analysis following Braun and Clarke's (2006) six-phase thematic analysis framework as outlined above. The results of the thematic analysis are presented in Section 5.3.2.

5.3. Results - Study 3

Descriptive analysis of the quantitative data that was collected during the course of Study 3 is presented first (Section 5.3.1.) and is comprised of means and standard deviation values from the SSQ6 (SSQN and SSQS), GSES, and PSS, which were administered initially for a baseline measurement and following each computer game play session. Following this, a top-down theoretical thematic qualitative analysis is presented (Section 5.3.2.) in which the focus groups and semi-structured interviews, which were conducted following each computer game play session, are examined.

5.3.1. Descriptive analysis.

The following descriptive information serves to summarise the collected sample data to provide an initial description of measured observations that were recorded during the intervention.

5.3.1.1. Social support.

Tables 5.3 and 5.4 display the mean scores and standard deviations of the SSQN and SSQS factors of the SSQ6 for each study condition at each measurement point of the intervention, respectively.

Table 5.3

Mean scores and standard deviations of the SSQN factor of the SSQ6 by study condition at each measurement point of the intervention

Time point	Group		Solo	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Baseline	2.56	0.92	1.92	0.35
Week 1	2.89	1.44	2.17	0.71
Week 2	3.05	1.55	2.00	0.71
Week 3	3.39	1.78	2.00	0.47

Baseline mean SSQN measurement identified that at the beginning of the investigation the group study condition reported higher SSQN scores than the solo study condition. The changes in mean SSQN scores when comparing baseline and week three SSQN measurements represent an increase in both study conditions. These changes represent a medium effect size of $d = 0.59$ for the group study condition and a below small effect size of $d = .19$ for the solo study condition.

Table 5.4

Mean scores and standard deviations of the SSQS factor of the SSQ6 by study condition at each measurement point of the intervention

Time point	Group		Solo	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Baseline	4.13	1.44	5.00	0.47
Week 1	4.25	1.43	4.83	0.23
Week 2	4.29	1.59	5.09	0.59
Week 3	4.46	1.55	4.67	0.47

Baseline mean SSQS measurement identified that at the beginning of the investigation the solo study condition reported higher SSQS scores than the group study condition. The changes in mean SSQS scores when comparing baseline and week three SSQS measurements represent an increase in the group study condition and a decrease in the solo study condition. These changes represent a small effect size of $d = 0.22$ for the group study condition and a medium effect size of $d = -0.70$ for the solo study condition.

5.3.1.2. Self-efficacy.

Table 5.5

Mean scores and standard deviations of the GSES by study condition at each measurement point of the intervention

Time point	Group		Solo	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Baseline	33.25	6.29	33.50	0.71
Week 1	33.00	5.89	35.50	2.12
Week 2	33.00	7.12	34.00	2.83
Week 3	34.50	4.65	34.50	0.71

Baseline mean GSES measurement identified that at the beginning of the investigation the group and solo study conditions reported similar levels of self-efficacy. The changes in mean GSES scores when comparing baseline and week three GSES measurements represent an increase in both the group and solo study conditions. These changes represent a small effect size of $d = 0.23$ for the group study condition and a large effect size of $d = 1.41$ for the solo study condition.

5.3.1.3. Perceived stress.

Table 5.6

Mean scores and standard deviations of the PSS by study condition at each measurement point of the intervention

Time point	Group		Solo	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Baseline	17.75	8.22	22.50	14.85
Week 1	15.25	8.85	22.50	16.26
Week 2	15.75	8.38	17.00	9.90
Week 3	14.50	6.45	15.50	2.12

Baseline mean PSS measurement identified that at the beginning of the investigation the solo study condition had higher recorded levels of stress than the group study condition. The changes in mean PSS scores when comparing baseline and week three PSS measurements represent a decrease in both the group and solo study conditions. These changes represent a small effect size of $d = 0.44$ for the group study condition and a medium effect size of $d = 0.66$ for the solo study condition.

5.3.2. Qualitative findings.

Data was collected for qualitative analysis from focus groups and semi-structured interviews, which were carried out following computer game play with group and solo study condition participants, respectively. Top-down theoretical thematic analysis produced four overarching themes as well as a range of supporting subthemes, which are presented in Sections 5.3.2.1. to 5.3.2.4. Themes are

supported with the inclusion of quoted excerpts from the data set, in each case they have been attributed to a particular participant anonymously using a code in which A1 and A2 represent the two solo study participants and B1, B2, B3, and B4 represent the four group study participants. Additionally, an indication of time point in which the information was recorded is included, W1, W2, and W3 representing week one, week two, and week three, respectively.

5.3.2.1. Theme 1 – Sociability of computer game play.

Theme 1 presents a range of information pertaining to participant's experiences and/or perceptions of mutual computer game play as a sociable experience due to the opportunities for interaction that it presents. Building on this, theme 1 is concerned with the initial step within the thesis' research model that identifies the capacity of sociable computer game play to facilitate social support in individuals, as highlighted in Figure 5.1 and is comprised of the following three subthemes; socially supportive actions, socialisation through computer game play, and preference for sociable computer game play.

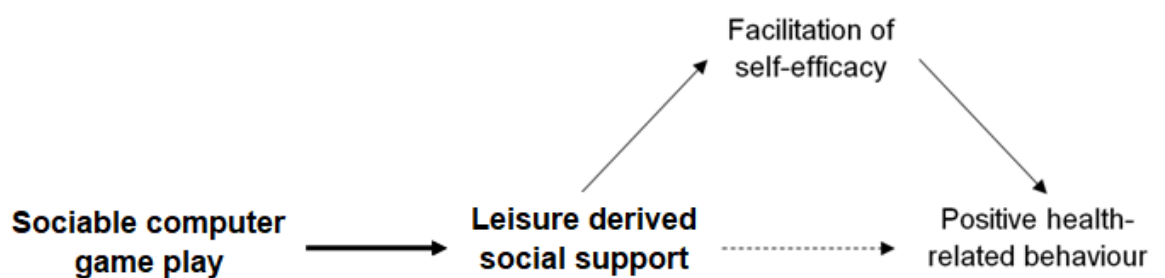


Figure 5.1. Research model with the theme 1 relevant pathway highlighted.

5.3.2.1.1. Subtheme 1 – Socially supportive actions.

This subtheme encapsulates distinct forms of social support following the actions of participants within the group study condition. Such distinct forms of social support follow those highlighted within Iwasaki and Mannell's (2000) hierarchical

model of leisure stress coping and include emotional support, esteem support, tangible aid, and informational support. Group study condition participants regularly indicated that they instructed and tutored each other in order to bolster their understanding of how to interact with each computer game activity (bowling, tennis, and golf).

“-Laughing- We’re, we’re all helping each other, trying to figure out how to, how to bowl.”

B3-W1

“Yeah, trying to work out the controls and sharing our in-depth understanding.”

B1-W1

It appears that some of the provided social support was done so with the goal of maintaining fair competition between players. It was recognised that participants who were unfamiliar with the computer game or who were struggling with the controls would not be able to perform competitively, which was viewed as an unfair advantage.

“It was more to level the playing field, so other players weren’t, were at least playing on the same under, on the same understanding.”

B2-W1

“Most of it was straightforward but, there were a few little bits that were worth advising each other on.”

B2-W2

This form of instruction could be described as being socially supportive due to the provision of information support as well as tangible aid through the communication of information regarding the rules of the computer game activity as well as direct demonstration of how to interact with it.

Furthermore, participants indicated that they provided esteem and emotional support to each other during their computer game play as well. This support was typically provided following particular outcomes within the computer game, such as losing or having a bad turn, or alternatively, when winning the game, for example.

“Celebrating each other’s successes and failures.”

B1-W2

A common element resulting in the provision of the various forms of social support often occurred following a shared frustration with the controls and methods of interaction that the computer game offered. A subtheme of player frustration with computer game play was identified and is described in Section 5.3.2.3.3.

“It’s good to realise that we were all struggling with the controls.”

B3-W2

“It felt good to be able to share the, have the shared frustration so that we could all take it not seriously and be silly.”

B1-W3

5.3.2.1.2. Subtheme 2 – Socialisation through computer game play.

This subtheme encapsulates the range of opportunities expressed by participants that the computer game afforded for socialisation and/or interaction between players, potentially as a means of facilitating the provision of social support.

“Like the, the double, I mean, if we’re looking at the Wii Sports the pairs tennis was probably slightly better to create a bond, in my opinion.”

B1-W2

Group study participants regularly expressed enjoyment with their engagement in the mutual computer game play each week. Initially, it appears that the computer game itself was used as a facilitator of socialisation through its respective game mechanics and the game play that it offered.

"Yeah, the nature of those, the party games, they're, sort of, encouraged, do require people to make it more entertaining."

B2-W1

"Yeah, because you got your teammate to, at least, try to coordinate with."

B2-W2

However, by the end of the investigation group study participants appeared to indicate that their enjoyment during computer game play occurred more-so from spending time on a mutual activity with one-another rather than from the particular computer game that they were playing.

"I'd say the actual game play wasn't particularly interesting one way or another, it was the group dynamic that made it, that made the time playing interesting."

B1-W3

As such, it would seem that the increasing familiarity with one-another that had been built during the previous weeks of computer game play was a substantial contributor to their social interaction and enjoyment during the final session.

"I think it's just gotten to the point where we're letting our hair down now and having a laugh really, rather than just playing the game."

B3-W3

"It's a yeah, so, just sort of making it more entertaining for ourselves, finding new ways to mess around with the game and see how it works."

B2-W3

Furthermore, another distinct form of socialisation between players was provided by opportunities for competition that participants were presented with, as can be seen in the following conversation between two participants.

"I mean, there was the element of competition but, it wasn't really because we were all so inept. It wasn't really competition, it was work."

B1-W2

"-Laughing- It was!"

B2-W2

"I'm only saying that because I didn't win."

B1-W2

The competition between group study condition participants presented socialisation opportunities within the computer game itself where players could react to their opponents game inputs, for example in the tennis game activity, or verbally, which occurred through playful taunting and competitive comments.

"I mean, I kicked everyone's ass at bowling."

B3-W1

"Mild ribbing. To not so mild."

B1 & B2-W1

"I look forward to winning at tennis."

B3-W2

Additionally, the role of competition within computer game play was also expressed as a fun part of the game play to engage in but, also as motivation for engaging with the computer game.

"Well, I mean, you can't play to win if there's no-one to win against, so it definitely enhanced it for me."

B3-W1

"You don't tend to go bowling on your own. You don't tend to go and play tennis on your own."

B1-W1

Furthermore, solo study participants expressed perceptions that having other players to compete with would bolster their engagement with the computer game.

"Like, you'd be more involved, because then you have the competition between each other."

A2-W1

As such, it would seem that the computer game provided opportunities for the specific provision of socially supportive behaviours between players during the

period of acclimatisation with the controls and inputs of the computer game.

Following this, socialisation and interaction with each other was facilitated through the computer game play, which encouraged participants to engage with each other within the confines of the game. In turn, as participants become increasingly familiar with one-another they described finding socialisation and enjoyment to occur more organically between them while engaging in a mutual activity.

5.3.2.1.3. Subtheme 3 – Preference for sociable computer game play.

This subtheme encapsulates the computer game playing preferences of participants within the group and solo study conditions. Participants expressed a number of distinct manners in which they find the most enjoyment in their computer game play, which are presented below.

Group study condition participants expressed a distinct preference for their engagement in sociable computer game play over that of playing the study computer game alone.

“Yeah, there’s no way I’d play that game on my own.”

B1-W2

“If I was playing that on my own I might actually have gotten a bit frustrated.”

B3-W2

“Sort of same, not really the kind of game I’d normally play so I wouldn’t find myself playing it unless it was a group event.”

B2-W3

Furthermore, solo study condition participants also expressed a preference to have played the study computer game sociably with other individuals. This appeared to be of importance for the solo study condition participants for two

reasons, firstly in order to facilitate social interaction leading to greater enjoyment from playing the computer game.

“But, obviously, if there was other participants then it’d give you more the encouragement to be more interactive with it, if that makes sense?”

A2-W1

“If there was other people to play with you’d kind of have the peer pressure to join in with the others as well and that, you know, to then have the social interaction from that.”

A2-W2

The second expressed reason was to facilitate the option for competition between players during computer game play which could facilitate social interaction as well as enhanced engagement within the computer game.

“There is only so much competition you can give yourself. It’d be better if I had, you know, someone else to compete with.”

A1-W2

“Yeah, absolutely, then you can rub your victory in their face as well.”

A1-W3

Additionally, it was also the case that the solo study condition participants expressed views suggesting that they would find engaging in sociable computer game play to be a socially supportive and beneficial experience. Such views that were expressed included viewing mutual computer game play as an opportunity for learning how to play the game better through receiving social support in the form of informational support or tangible aid from other players.

“Yeah, I mean, I could always ask them, what they’re doing, to get so good and hopefully they’ll tell me.”

A1-W2

On the other hand, receiving and potentially providing emotional and/or esteem support was also considered as a possibility through sociable computer game play by the solo study condition participants.

“Obviously, it’d be interesting, you know, just to get to know them and things and have that social side to it.”

A2-W3

“They might give you some constructive criticism on, you know, a problem at work or something, so obviously, you kind of get social support with issues you’ve had, sort of thing.”

A2-W3

“I mean, it’s almost impossible not to be playing with somebody in a manner like that and not get to know them better. So, yeah, probably have even made friends.”

A1-W3

Lastly, the manner in which sociable computer game play occurred also appeared to be important. Participants within the group study condition indicated that co-located, or local, mutual computer game play was the most enjoyably way to interact with the computer game, rather than networked non-co-located computer game play.

“Yeah, the nature of the Wii games are much better for people in the same room.”

B2-W1

“However, when it’s a local area network, LAN, game and there’s four or five people sat next to each other and you can talk to them socially and it’s a cooperative type thing, or even if it’s against each other but you’re all sat in the room and you can shout to each other that’s, I find that very socially bonding.”

B1-W2

A similar perspective was also shared within the solo study condition participants who indicated that they would have enjoyed engaging in the computer game in particular with others who were co-located with them.

"I don't think you can beat a local multiplayer game as far as fun and atmosphere is concerned."

A1-W1

"If you manage to get several strikes in a row, or whatever, or, you know, do a good score you'd have other people to kind of enjoy that with you rather than just yourself."

A2-W1

"So it feels like there's something missing when you do it on your own."

A1-W3

Participants indicated that an important aspect of locally based mutual computer game play was that it provided the opportunity to observe body language and gestures, as well as vocal communication between players, which boosted the enjoyment of the computer game play.

"Whereas, when we're playing as a group, the reward you get is with the laughter and reaction of who you're playing with."

B1-W3

"Yeah, I think working together to break it and see how silly we can get with the controls was probably the more entertaining part of it."

B2-W3

This also appeared to be of importance for competitive computer game play to be more enjoyable as participants could observe their opponent's reactions to certain actions within the computer game.

"Because you're seeing the reactions of other people, you know, there would be mocking them or, you know, taking the defeat. Just adds a little bit more intensity to the situation so therefore, more enjoyable in my opinion."

A1-W1

Overall theme 1 encapsulates the variety of ways that mutual computer game play was considered to be a sociable endeavour to the group study condition participants and was perceived to be a desirable activity to engage in by the solo study condition participants. It would seem that the sociable computer game play

facilitated an environment suitable for the gaining of social support as well as positive social experiences.

5.3.2.2. Theme 2 – Social support facilitating a sense of self-efficacy.

Theme 2 is concerned with the second step within the thesis' research model which posits that social support, derived from sociable computer game play, facilitates a sense of self-efficacy, as highlighted in Figure 5.2.

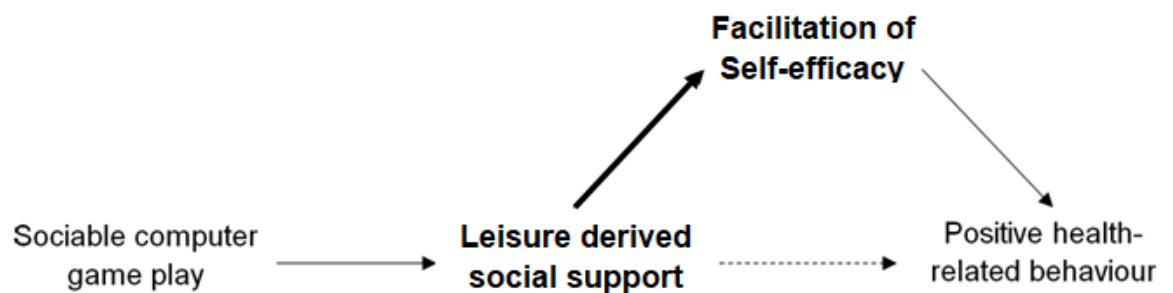


Figure 5.2. Research model with the theme 2 relevant pathway highlighted.

The explicit identification of a beneficial effect of the intervention on participant's levels of perceived self-efficacy following the effect of an increase in social support was not achieved through the present study's qualitative analysis. It is possible that a sense of self-efficacy is not something participants were consciously thinking about in relation to their participation within the present study and as such, self-efficacy was not directly addressed within any of the interviews or focus groups.

However, participants within the group study condition did express viewpoints regarding their participation within the study and a potential effect this may have had upon their sense of confidence. These participants expressed a sense of feeling more at ease and comfortable with the other members of their 'team' and thereby an increased sense of confidence in engaging in mutual computer game play. Participants within the solo study condition did not appear to express points

of view or opinions regarding their computer game play influencing a perceived sense of confidence or similar concept.

“Feeling more comfortable around each other to be able, to be able to let down our hair to be silly.”

B1-W3

“Now that we’re familiar with one another everyone else can mess around and it didn’t feel as, it felt more appropriate to do this then, sort of, instead of potentially disrupting things on the first week with being silly.”

B2-W3

“But, as I’ve become more familiar with the people, with the game, you know, it has got to the point now where we are messing about and having a good time.”

B3-W3

A sense of confidence is not explicitly synonymous with perceived self-efficacy. Bandura (1997) explains that confidence is a nondescript concept associated with strength of belief in an unspecified activity, whereas self-efficacy pertains to perceived agency in the successful completion of a specific task for a desired outcome. As such, this theme presents some evidence pertaining to the perceived effect of sociable computer game play on a sense of confidence, which appears to have been influenced through sociable behaviour. However, the gathered qualitative evidence does not indicate that participants experienced a change to their levels of self-efficacy following participation with this investigation. It is possible that the group study participants may have experienced changes to their perceived levels of self-efficacy and articulating it through the lens of confidence may have simply been a convenient manner in which the participants chose to communicate it.

5.3.2.3. Theme 3 – Reduction of perceived stress from sociable computer game play.

Theme 3 is concerned with the effect of sociable computer game play on perceived levels of stress. As such, theme 3 presents information pertaining to the positive health-related behaviour change outcome of the research model, as highlighted in Figure 5.3 and is comprised of the following three subthemes; sociable computer game play and perceived stress, solo computer game play and perceived stress, and frustration with the computer game.

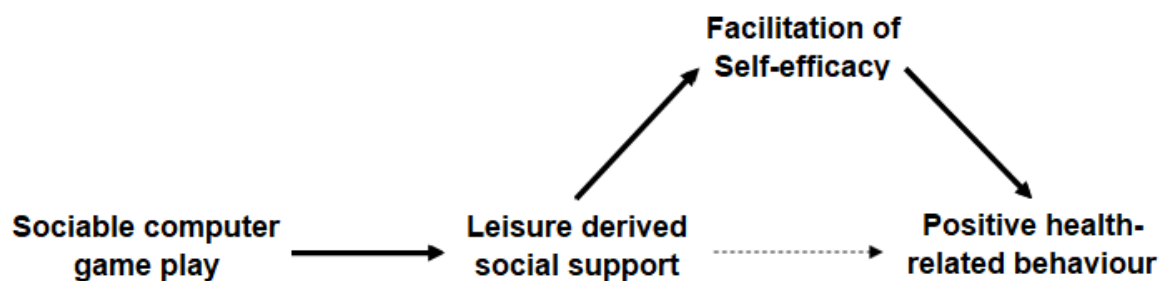


Figure 5.3. Research model with the theme 3 relevant pathway(s) highlighted.

5.3.2.3.1. Subtheme 1 – Sociable computer game play and perceived stress.

This subtheme encapsulates the stress-related experiences and perceptions of participants within the group study condition over the duration of the investigation. Participants within the group study condition appeared to report states of perceiving at least some stress as well as experiencing minor stress relief following sociable computer game play at the start of the investigation.

“I would say, I wasn’t stressed to start with and then I got annoyed at the bowling so I became more stressed and then with the shared knowledge of the rest of the team my stress eventually returned to the pre-game state.”
B1-W1

“I guess, for me, it’s sort of, chill out a bit more.”
B2-W1

The perception of stress appeared to decrease as the investigation progressed and culminated following the third week of sociable computer game play. In the final focus group participants within the group study condition expressed some belief that the weekly sociable computer game play was indeed beneficial in helping them to relax and reduce their perceived stress.

“Fairly, fairly relaxed.”

B2-W3

“Yeah, I think it’s been a whole, sort of, light-hearted experience. I’m not really feeling any stress at all, I’m feeling like, you know, we’ve just had a good laugh and a good time.”

B3-W3

“I would personally say that my non-familiarity with the game at the first week caused the stress and now I’m familiar with the game I’m at a neutral stress level overall.”

B1-W3

In addition to the above evidence for the stress relieving properties of sociable computer game play, participants within the solo study condition expressed some beliefs that participation within mutual computer game play would have stress relieving properties.

“Yeah, because, obviously, if, if, there’s like a function to interact with others, you know, it distracts you from the real world basically.”

A2-W2

Solo study condition participants went further to express that the stress relief potentially facilitated by sociable computer game play would occur through the provision of social support.

“Cool, yeah I think you can get a lot from playing with other people. It’s, you know, whether it be their supportive side or competitive side or working together to, to, you know, improve.”

A1-W2

“So, you know, you can kind of get the social benefit that way through it and obviously you get the stress relief from “oh okay, that’s a constructive way to deal with it” rather than just sitting and mulling it over on your own so you do get, kind of, you would get the social support sort of thing.”

A2-W3

It seems that participants within the group study condition believed that their sociable computer game play was beneficial in terms of relieving their stress. This stress relief appears to have occurred over time, with participants expressing a stronger belief of it having occurred by the culmination of the investigation. This delayed response would support the arrangement of psycho-social concepts under investigation within the research model (Figure 2.12). This is because it is expected that following sociable computer game play it would take time for health-related positive behaviour change, such as stress relief, to occur as social support and, in turn, self-efficacy need to be influenced beforehand.

5.3.2.3.1. Subtheme 2 – Solo computer game play and perceived stress.

This subtheme encapsulates the stress-related experiences and perceptions of participants within the solo study condition over the duration of the investigation. Participants within the solo study condition reported deriving little to no stress-relieving experiences following their computer game play across the investigation.

“Oh, right, yeah. Because I believe I wasn’t too stressed last time anyway so. I, I, feel like there’s not been much of a change in that regard.”

A1-W2

“I’d probably say that it has not made a difference.”

A2-W2

“I’m a year older so maybe that’s a reason to be a little more stressed. But, other than that no, it’s all been fine.”

A1-W3

“So yeah, I’d probably say, you know. I’m not worse off but I’m not better off, sort of thing.”

A2-W3

Furthermore, a participant within the solo study condition explained that the computer game play was often insufficient to take their mind off of their daily troubles and prevent them from dwelling on stressful thoughts such as problems at work, for example. This point of view, however, was not shared was not expressed by the other solo study condition participant.

“Mainly because, obviously, like I said, that because the game wasn’t quite as immersive it didn’t really take my mind off the stresses of the day. It just gave me time to, kind of, mull over them more.”

A2-W2

“It’s not massively been stress relieving because, obviously, it got a bit repetitive again so you kind of just go back and dwell because you’ve not really got as much of a distraction for your mind.”

A2-W3

It is possible that sociable computer game play was capable at engaging the group study condition participants in a single mutual activity which prevented negative thoughts or stressors being dwelled upon, which was discussed previously within this subtheme.

5.3.2.3.1. Subtheme 3 – Frustration with computer game play.

This subtheme outlines a common viewpoint that was expressed by both the group and solo study conditions regarding the experience of frustration or annoyance at times when engaging with the computer game. This frustration was typically associated with awkward or imprecise controls during computer game play resulting in undesired outcomes within the computer game.

“Yes, non-responsive or they didn’t do what I was expecting it to do”

B1-W3

"It was different to what we were playing last week, so it was another learning curve and dealing with the sensitivity of the controls, or lack thereof."

B2-W2

"Still quite frustrated with if I was trying to play the game properly, the controls were. Inhibiting. -Participant laughing-"

B1 & B3-W3

Despite the perceived awkwardness of the computer game's controls the group study condition participants appear to use this to their advantage as an opportunity to bond socially with one-another. This was most prominent in the final week of computer game play where participants had become familiar with each other and engaging in experimental computer game play felt appropriate.

"It was definitely enjoyable. We got to the point of experimenting more with the game and how the game and motion controls work. So now that we're familiar with it we spent more time trying to break it, so to speak"

B2-W3

"Yeah, at this point we were just, pretty much, larking around in the game really. Finding our own fun -participant laughing- outside of the, outside of the intended purpose of the game."

B3-W3

"Where it's motion capture so basically working out that you can do pretty much any old manoeuvre with the controller and get a result."

B1-W3

Participants also provided some discussion regarding frustration that was attributable to the game mechanics (constructs of rules and methods for game interaction) present within the study computer game as well. An example of this includes the perception of random, and therefore, unpredictable events occurring within the computer game.

"Yeah, obviously, I found that one agitating because, like, the random element into it. So yeah, it was a case of I wanted something that I felt, you know, I had more control over to actually interact with more."

A2-W3

Additionally, the golf activity did not follow a strict circular turn sequence for players, instead the turn sequence was determined by which player was furthest from the hole. This resulted in some players not having many turns or having to wait a long time between each turn.

“Some players end up waiting a fair amount and it almost feels like the people who are doing better might be punished for, well feel a bit punished, in the sense that you have to wait 20 minutes while everyone else tries to catch up.”

B2-W2

“Yeah, you did well and now you have to wait.”

B1-W2

“Yeah, it, it, it feels that there’s a bit of uneven game play going on as a result.”

B2-W2

Overall theme 3 encapsulates the broad range of participant’s beliefs and experiences in how their perceptions of stress were influenced through their computer game play and the potential social interactions that occurred during the game play. It appears that, typically, the group study condition participants experienced a positive effect on their perceived stress by the end of the third week of the investigation, an opinion that did not appear to be shared by the solo study condition participants. Participants in both of the study conditions did however experience some frustration during their respective computer game play due to a perceived awkwardness of the controls or the mechanics of the computer game itself. However, this appears to have become a sociably-positive element of interaction with the computer game in the case of the group study condition, which led to experimentation with the computer game and further opportunities for socialisation.

5.3.2.4. Themes unrelated to the research model.

This section contains themes identified within the qualitative dataset that did not fit into the research model pathways but were still of relevant interest and worthy of inclusion within this thesis.

5.3.2.4.1. Theme 4 – Solo study condition self-competition.

Participants within the solo study condition indicated that a prominent manner in which they entertained themselves whilst engaging in computer game play during the course of the investigation was by attempting to improve their game playing ability and engaging in competition with themselves.

“Yes. Thankfully, I was able to do all the games that I err wanted to in this round. So, it should be easy to mimic that again and see what the difference is.”

A1-W1

This was typically achieved by attempting to better their skills within the computer game during each session in order to accumulate better scores and thereby surpassing any records that they previously had set.

“I had a chance to play the game and compete with myself, so to speak, had a bunch of goals in mind to challenge myself against from last time and I managed to find the games that I did and repeat the process to see if I’d improved.”

A1-W2

“Yeah, yeah, it certainly has been. Seeing some sort of progress that’s measurable has been great.”

A1-W3

This emphasis on progressive improvement at the computer game and using scores as a recordable measurement was a viewpoint expressed repeatedly by both of the solo study condition participants following each session of solo computer game play.

“So, because obviously, I chose to play the same one because then I could see the fact my score would hopefully be getting better each time. So, I played it more, you know, as an achievement thing, for the points that you got at the end.”

A2-W1

“The fact that I could like aim just to improve each time and think, you know, learn how the mechanics work so I could continue improving whereas with this one it seemed more random chance.”

A2-W2

“Yeah, I’d say it was about the same as from the first week of, you know, yes I was trying to better myself but, it was a case of if you’re not then it’s not very rewarding really.”

A2-W3

The focus on the honing of skills to perform better at the computer game’s activities was, however, a potential source of frustration for a solo study condition participant that was identified in the frustration with computer game play subtheme of theme 3 (Section 5.3.2.3.1.). The participant expressed that some of the Wii Sports activities behaved in a random or unpredictable sense making it difficult to achieve a sense of progression or improvement over the course of the investigation.

“Yeah, I, I, so it was much harder to actually get a, get better at it because of, just the fact that it was a bit more random. So there’s less sense of achievement in a way because you’re not getting as higher score.”

A2-W2

“No. I had played Wii Sports before and I know when playing the golf it seemed a bit more random than the other games so where I wouldn’t of really had an aim, or achievement, or a goal, to me there would be no point in playing it.”

A2-W3

5.4. Discussion - Study 3

The evaluation of Study 3 involves commentary of the design, method, and analytical strategy that was used as well as a discussion of the study's findings in relation to Study 2 and the to the broader theoretical framework of the thesis.

5.4.1. Discussion of design, method, and qualitative analysis.

Evaluation of Study 3's design, method, and qualitative analysis is presented within this subsection. Similar to the equivalent subsections found in Study 1 and Study 2's discussion sections the purpose of this evaluation is to consider the strengths and weaknesses of the study design, method, and analytical techniques that were used within the present study.

5.4.1.1. Design.

Following the opportunistic recruitment of six participants into Study 3, four of these participants were randomly assigned into the group study condition to engage in weekly mutual computer game play. Following each week's mutual computer game play these group study condition participants were invited to participate in a focus group, which participants consented to. However, during the three focus groups it became clear that one of the group study condition participants did not particularly engage in the discussions. This is potentially attributable to the participant in question typically working night-shifts and due to the appointment time of the study each week this participant may have been too fatigued to engage in the focus groups. As such, the qualitative evidence from the group study condition that is presented within this chapter is taken almost entirely from the information provided by three participants, not the originally expected four.

In Study 3, a three week duration was decided upon for the experiment to be conducted over, which was informed from the rationale behind the performing of mediation analyses in Study 1 and 2 using data sequential from sequential weeks. It is logical to assume that any changes experienced in social support would be seen to impact self-efficacy at the subsequent measurement point, and so-on for perceived stress (being affected by changes in self-efficacy). The decision to conduct Study 3 over a three week duration, instead of the eight week duration used in Study 1 and Study 2, appears to have been appropriate. As reported in Section 5.3.2., the performed thematic analysis has identified themes relevant to the thesis' research model and theoretical framework and, as such, appears to have been successful in investigating these constructs of which the study had set out to do.

There are a number of limitations which are systemic to qualitative research and are present within Study 3. Firstly is that of ambiguity in language, which human discourse is subject to. Qualitative analysis can identify and comment on perceived ambiguities within a data set, however the researcher cannot be certain about the particular meaning of a participant when language with multiple potential meanings has been used (Ochieng, 2009; Poindexter, 2003). An example of this is the identified distinction between a sense of confidence and self-efficacy that was described in theme 2 (Section 5.3.2.2.). In this case it is not clear if participants were alluding to an increased sense of self-efficacy using vocabulary that was familiar to them, or simply that they experienced an increased sense of confidence.

A second problem in qualitative research is the limited applicability of findings to other contexts and the wider population (Cheek, Onslow, & Cream, 2004). This

occurs due to the typical recruitment of smaller sample sizes within specific research contexts, which are less likely to be representative. Additionally, qualitative outcomes do not involve tests to determine the probability of findings being attributable to chance or not, unlike analytical tests in quantitative research (Ochieng, 2009).

5.4.1.2. Method.

A potential criticism of Study 3 is that of the size of the sample that was recruited, which due to the limited statistical power that this resulted in meaningful data screening, statistical analysis or inference could not be performed. However, as the primary scope of Study 3 was to collect qualitative evidence this potential criticism carries less weight.

Following the identification of the use of numerous laboratory spaces during a single investigation as a potentially confounding variable the present investigation was carried out exclusively in a single laboratory. This ensured that participants were exposed to as similar a research context as Study 2 participants were as possible. In doing so, the qualitative findings of Study 3 and the quantitative findings of Study 2 may be more readily compared and contrasted.

5.4.1.3. Qualitative analysis.

As described, the present investigation adopted the previously generated research aims and questions that Study 1 and Study 2 also aimed to satisfy. This led to a top-down or theoretical thematic analysis being utilised and as such during focus group and semi-structured interview sessions the researcher was interested in covering topics pertaining to a participant's experience of social support/sociability following computer game play, perceived self-efficacy, and perceived stress.

However, due to the use of concept elicitation these topics were not explicitly asked about, instead more general open-ended questions or prompts were used. The benefit of this is that it provides the opportunity for participants to express concepts that are pertinent to them spontaneously and of their own accord. This ultimately provides trustworthiness to the qualitative data as it represents a participant's own point of view in their own language and terminology.

As such, a potential drawback of the qualitative techniques that were used within Study 3 is that participants did not distinctly discuss a sense of self-efficacy or make reference to it. Participants within the group study condition did however appear to discuss a perceived effect that the intervention had on their confidence, which could potentially be interpreted as akin to that of self-efficacy from a non-technical point of view. In order for this uncertainty to be clarified, participants would have needed specific questions, prompts, and explanation of the construct of self-efficacy. This may have been harmful to the integrity of the performed thematic analysis and focus group/semi-structured interview process by potentially shaping the responses of participants.

Otherwise, the application of a top-down theoretical thematic analysis was effective in investigating the associations between sociable computer game play, social support, self-efficacy, and positive health-related behaviour change within the present investigation. This is due to various strengths that the method of thematic analysis possesses, in that it is an accessible approach that is theoretically and epistemologically flexible (Braun & Clarke, 2006).

5.4.2. Discussion of findings.

This section includes a summary of the qualitative analysis findings, which is followed by the application of the findings to the quantitative findings of Study 2 and the wider psychological literature.

5.4.2.1. Summary.

The performed top-down theoretical thematic analysis yielded three overarching themes that were of direct interest in regards to the research model; (1) sociability of computer game play, (2) social support facilitating a sense of self-efficacy, and (3) reduction of perceived stress from sociable computer game play. Themes 1 and 3 were comprised of three subthemes each and theme 2 did not contain any subthemes. The subthemes comprising theme 1 were; (1) socially supportive actions, (2) socialisation through computer game play, and (3) preference for sociable computer game play. The subthemes comprising theme 3 were; (1) sociable computer game play and perceived stress, (2) solo computer game play and perceived stress, and (3) frustration with computer game play. A fourth overarching theme was also identified and titled solo study condition self-competition, which was not of strict interest to the specific research aims and questions of the investigation but, despite this, contributed some meaningful information.

Theme 1, sociability of computer game play, encapsulates the facilitation of social support following sociable computer game play. The theme presents an array of ways in which participants experienced their mutual computer game play facilitated the opportunity to provide and receive social support as identified within Iwasaki and Mannell's (2000) hierarchical model of leisure stress coping as well as

socialisation. Furthermore, it was also identified that solo study condition participants held opinions in which they felt mutual computer game play was capable of facilitating the socialisation and social support that the group study condition participants expressed had indeed occurred. Lastly, participant opinions also appeared to indicate a preference for playing the computer game in a sociable manner, with group study condition participants indicating that they would not play the computer game on an individual basis. Overall, theme 1 presented valuable information pertaining to the opportunity for socialisation and the provision of social support that mutual computer game play can offer.

Theme 2, social support facilitating a sense of self-efficacy, encapsulates the association between social support, derived from sociable computer game play, and an increased sense of self-efficacy. Theme 2 is potentially the weakest of the three overarching themes that pertain directly to the thesis' research model due to the qualitative data not being specific to the concept of self-efficacy. Despite this, participants did express opinions regarding an increased sense of confidence as a product of sociable computer game play, which was not reflected in the solo study condition. This sense of confidence could be argued to be akin to that of self-efficacy and was simply the most straightforward manner in which to articulate it, especially so if participants lacked the specific technical knowledge of self-efficacy concept.

Theme 3, reduction of perceived stress from sociable computer game play, encapsulates the overall research model and the positive health-related behavioural outcome of reducing perceived stress following sociable computer game play. Through the presented subthemes the range of stress-responses from sociable and individual computer game play are captured including opinions

expressing a positive stress relieving viewpoint and the occurrence of frustration and negative game play experiences. Typically, sociable computer game play appeared to have a beneficial impact upon perceived stress by the end of the investigation, which has provided valuable qualitative evidence as to the role that sociable computer game play may have in facilitating positive health-related behaviour change.

Theme 4, solo study condition self-competition, did not particularly relate to any component of the research model however it did encapsulate distinct interesting computer game play interaction that occurred within the solo study condition. Due to there being no opportunity for competition or interaction with other individuals, the solo study condition participants appeared to create their own amusement by competing with themselves by using the points/scoring systems within the computer game and using this as an opportunity to develop their skills at the computer game. Without the addition of this qualitative investigation, this element of motivation for solo computer game play would not have become apparent from the exclusively quantitative investigations of Study 1 and Study 2.

5.4.2.2. Application of qualitative findings to Study 2's outcomes and theoretical framework.

Because Study 2's experimental protocol was replicated within the present investigation it is worthwhile to consider the outcome of the qualitative investigation in relation to the quantitative findings of Study 2. It is hoped that by including the presented qualitative evidence the additional information can be used to further solidify the associations between the psycho-social constructs that have been investigated in this thesis' research model.

The performed 3×2 Mixed ANOVA and ANCOVA in Study 2 did not identify any statistically significant differences within predicted direction. However, the performed mediation analysis did identify cases of indirect-only mediation, which was predicted suggesting that self-efficacy mediated a relationship between social support and reduced perceived stress. The qualitative evidence that has been presented within this chapter provides additional meaningful information building on the quantitative findings of Study 2. Through the range of themes that have been identified and reported following thematic analysis, a richer understanding of how sociable computer game play can be facilitative of positive health-related behaviour change has been achieved. The presented themes have identified, from participant's own experiences and words that a sense of social support and socialisation can be facilitated through sociable computer game play. This computer game play facilitated social support appeared to also contribute to feelings of confidence and reductions in perceived stress. As such, the inclusion of qualitative evidence into the present thesis complements the previously reported quantitative analyses by providing richer meaningful data expressed directly from participants' own points of view and opinion.

In relating the findings of the qualitative analysis to the broader psychological literature, it can be seen that a number of the presented themes reflect findings similar to other investigations. For example, participants within both study conditions appeared to perceive their computer game play as being inherently sociable, a concept explored within Stenros et al. (2009). This was most obvious in the group study condition where there was a distinct opportunity to play with others. However, solo study condition participants perceived an inherently sociable aspect of the computer game in its' scoring systems, in which it was suggested

that this feature could provide the opportunity to engage socially with other people by comparing scores, for example.

As outlined by Coleman and Iso-Ahola (1993), Schneider and Iwasaki (2003), as well as Iwasaki and Mannell's (2000) hierarchical model of leisure stress coping, leisure is a highly social activity that is integral in forming inter-personal relationships and thereby developing a resource of social support. Group study condition participants indicated an increasing familiarity and enjoyment in playing the computer game with each other as the intervention proceeded. This suggests that inter-personal relationships may have begun to form as a product of the leisure participation.

It is unsurprising that the solo study condition participants regularly expressed viewpoints that they would prefer to have played the computer game with other people. The desire to engage socially with other people is a distinct motivation for computer game play as identified in a range of previous research (Cole & Griffiths, 2007; Jansz & Tanis, 2007; Longman et al., 2009; Park et al., 2011; Reinecke, 2009b; Westwood & Griffiths, 2010; Williams et al., 2006; Williams et al., 2008; Yee, 2006a, 2006b) as well as the findings of the present study.

Relating the qualitative findings concerned with self-confidence to the broader psychological literature is not as clear due to the previously described potential ambiguity between self-confidence and self-efficacy. Despite this, participants expressing an increased sense of self-confidence/self-efficacy in addition to their perceived increase in social support are within expectations (Bandura, 1977; Resnick et al., 2002).

Participants within the group study condition expressed that they felt less stressed by the end of the intervention and held viewpoints that this was due to a more relaxed atmosphere and increased familiarity with each other leading to a more enjoyable computer game play session. Bedini et al. (2017) found a positive association between the quality of leisure time and the reduction of perceived stress. As such, towards the end of the intervention the group study condition participants may have viewed the computer game play sessions as quality leisure time thereby reducing their perceived stress. This viewpoint is supported by the participants indicating that they enjoyed playing the computer game and the sociable interactions that were facilitated by it during the final week of the intervention.

A broad range of literature presented in Section 4.2.2. identified the importance of social support in the stress-health relationship in which a lack of social support was consistently associated with poorer general health and increased stress perception (Anjara et al., 2017; Cacioppo et al., 2002; Hawkley & Cacioppo's, 2007; Hawkley, et al., 2008; Jou & Fukada, 2002; Lauder et al., 2006; León-Pérez, et al., 2016; Schwarzer et al., 1994; Segrin & Passalacqua, 2010). The presented qualitative findings of Study 3 contribute additional pertinent information regarding participant's experiences of the relation between social support, facilitated through sociable computer game play, self-efficacy, and perceived stress.

5.4.3. Future avenues of inquiry.

The supplementation of qualitative evidence into the present thesis has been valuable and significant. Further broadening the inclusion of qualitative data into the investigation of sociable computer game play could yield further insight into

how the technology could be used for beneficial outcomes. One way in which this could be achieved is through the collection and analysis of qualitative data during the sociable and solo computer game play each week, which could be achieved through filming or audio recording. In doing this, genuine participant interactions, in the case of the group study condition, could be captured as they participate to further examine precisely how social support is offered and received as well as socialisation behaviour. In the case of the solo study condition observation of their self-competition and point-scoring behaviours could provide additional information as to how they choose to engage with the computer game. There are potential issues surrounding collecting this data however with participant's knowledge of being recorded, as it may interfere with the relaxed or informal atmosphere that engaging in computer game play would typically be expected to produce.

Additionally, following the identification of the subtheme, frustration with computer game play, similar future research investigating computer game play and its psychosocial effects may benefit from more extensively trialling the computer game used. It became apparent that some participant's considered certain aspects of the Nintendo Wii Sports computer game to be frustrating or awkward, such as the sensitivity of controls or the turn sequencing in the golf activity, for example. Despite this, it was possible to identify the potential for socialisation that awkward controls presented within the group study condition. Had a different computer game been selected for the purposes of this investigation it is possible that this information would not have been identified.

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6.1. Overview

This chapter acts as a comprehensive evaluation of the original research that is presented within this thesis and its potential meaningful impact upon psychological literature. In order to achieve this, evaluation regarding Study 1, 2, and 3's findings, limitations, and original contributions to knowledge, as a whole, are made. Furthermore, the aims of the thesis and subsequent research questions, which are reported below, are each considered in relation to the conducted research. The discussion sections of Studies 1 (Section 3.5.), 2 (Section 4.5.), and 3 (Section 5.4.) aimed to evaluate elements that were specific to each study in terms of their design, method, and analyses as well as applying the findings of the studies to their respective literature. The present chapter builds on these discussions by addressing and evaluating the elements of research design, method, and analysis, including potential limitations, which were common to Studies 1, 2, and 3. The thesis' theoretical underpinnings and broader psychological knowledge is applied to the findings of Studies 1, 2, and 3 in order to ascertain the meaningful contribution to psychological knowledge that has been made in this thesis as a whole. Following this evaluation, considerations are made regarding future meaningful avenues of inquiry that have been made possible by the present research.

6.2 Aims of the thesis and research questions

As a product of the extensive literature review (Chapter 2) the following series of research aims were developed:

Research Aim 1: to investigate the capacity for computer games, through sociable game play, to elicit social support, self-efficacy, and health positive behaviour.

Research Aim 2: to investigate if sociable computer game play can be used as a therapeutic tool across a range of health outcomes.

Research Aim 3: to investigate the mechanisms of action on health positive behaviour from social support and self-efficacy.

In order to better investigate these aims, the following series of research questions were developed:

Research Question 1: does sociable computer game play have the capacity to facilitate social support?

Research Question 2: does social support, potentially facilitated through sociable computer game play, in turn, facilitate self-efficacy?

Research Question 3: does self-efficacy mediate a relationship between social support, potentially facilitated through sociable computer game play, and positive health-related behaviour?

In order to answer the research questions and determine if the aims of the thesis have been met, the findings of Studies 1, 2, and 3 will be considered together and discussed within this chapter.

6.3. Synthesis of findings

Following the performed literature review (Chapter 2) a number of shortcomings were identified within the literature, which presented the opportunity for new research to be conducted which could contribute to the field of health psychology. The identified shortcomings within the literature were as follows.

1). A number of studies have identified computer game play as being facilitative of social support. However, little research has been published which builds upon this information.

2). Much of the published research has investigated either a single outcome or a handful of outcomes in relation to computer game play. However, there has been little research produced attempting to synthesise such psycho-social concepts together and, instead, have typically treated them as independent concepts.

Consequently, space within the academic literature was identified for novel arrangements of psycho-social concepts and the application of theory, with the purpose of establishing a thorough explanation of how sociable computer game play may be used to facilitate positive health-related behaviour change.

Establishing a model of sociable computer game play facilitative of positive health-related behaviour change would provide evidence to support the use of this technology as a therapeutic tool for the general public, which is affordable, engaging, and at present regularly found within many households.

The existing literature which established computer game play to be facilitative of social support provided the basis for the initial novel application of theory in Iwasaki and Mannell's (2000) hierarchical model of leisure stress coping. This model was originally conceptualised as a means of describing how leisure might be used to provide leisure stress-coping effects. However, the present thesis identified the model as being appropriate for the purpose of establishing the socially supportive nature of leisure, which produces a motivational drive for an individuals' engagement in leisure.

Following this, self-efficacy was investigated due to its prevalence within many models of behaviour change, such as the theory of planned behaviour, and therefore has been broadly acknowledged within health psychology as a fundamental principle in successful programmes of positive health-related behaviour change. In reviewing the published evidence an association between social support and self-efficacy was established, in that being socially supported an individual is more likely to then engage in beneficial or novel behaviour, such as exercise. The identified associations between leisure, social support, self-efficacy, and positive health-related behaviour change produced a research model involving the original arrangement of these specific psycho-social concepts in relation to sociable computer game play that was investigated within the presented research. The research model, initially depicted in Figure 2.12., is reproduced below, for convenience.

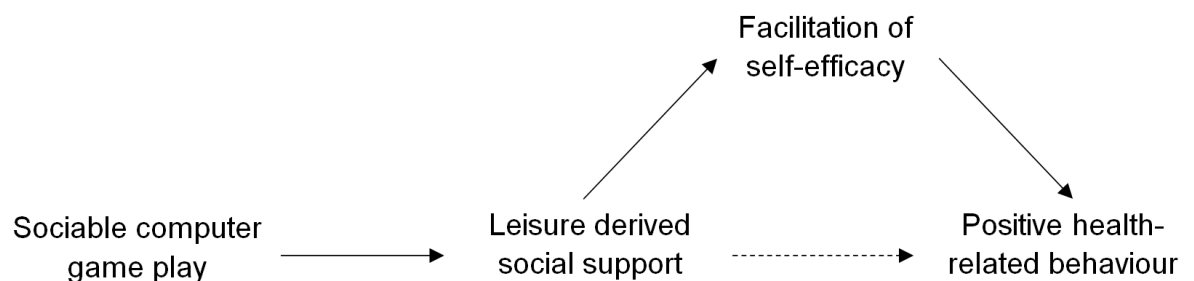


Figure 6.1. Research model (initially depicted in Figure 2.12.).

In order to test the appropriateness of the developed research model, intervention-based research needed to be conducted, which would aim to produce positive health-related behaviour change as a product of sociable computer game play. It was decided that a series of studies would be conducted in order to establish the efficacy of the model across different behavioural outcomes. Identifying an effective model that could be adopted to facilitate a range of behavioural outcomes which uses readily affordable and accessible technology would provide health

psychology, and society as a whole, with a potentially powerful therapeutic tool. Increasing physical activity and reducing perceived stress were selected as the behavioural outcomes of interest to be investigated within this thesis. These were selected due to the prevalence of physical inactivity and stress, and their associated related disease(s), which represent significant costs to the NHS as well as the economy from potential lost earnings due to illness, as explored in Sections 3.2.1. and 4.2.1.

6.3.1. Study findings and research questions.

In evaluating the findings of Study 1, Study 2, and Study 3 this section applies the outcomes of the presented studies to the thesis' research questions in order to establish the effect of the performed research on the specific objectives of the thesis.

6.3.1.1. Research Question 1: does sociable computer game play have the capacity to facilitate social support?

The NHST analytical techniques (3×2 mixed ANOVA and ANCOVA) that were used within Studies 1 and 2 would suggest that sociable computer game play is not facilitative of social support. This was because the inferential tests that were used to assess hypotheses $H_{1a}-H_{1c}$, $H_{2a}-H_{2c}$, $H_{4a}-H_{5c}$, and $H_{5a}-H_{5c}$ were either non-significant, or in the case of significant findings they were not in the predicted direction.

However, with the inclusion of MBI supplementing the NHST analyses, the additional information provided would indicate that sociable computer game play is indeed facilitative of social support. Specifically, this was the case in Study 1 when comparing the group and solo study conditions for satisfaction with social support

(SSQS) with 3×2 ANOVA and for quantity of social support (SSQN) with ANCOVA. In the two instances in which unclear inferences for social support were made (SSQN and 3×2 mixed ANOVA; SSQS and ANCOVA), upon the application of qualitative descriptors to define the likely range of the effect(s) based upon the upper and lower ends of the confidence interval(s) it can be seen that the effects were, at most, more likely to be positive than negative in both instances.

These findings highlight the usefulness of MBI and the potential limitations that are associated with NHST. If the present research had exclusively used NHST techniques then it would be concluded that, in the case of social support, few statistically significant findings had been found and the interpretation of this would consider the interventions conducted in Study 1 and Study 2 to have been ineffective. In using MBI it can be seen that, despite statistically non-significant findings, there is still meaningful information comprised of probabilities determining that the true value will have the observed magnitude and lies within one of three magnitudes (negative/harmful, negligible/trivial, or positive/beneficial). In producing this meaningful information from MBI analysis the typical dichotomy of thought from NHST can be avoided where it is an oversimplification to consider an effect to be important (statistically significant) or not important (statistically non-significant).

Furthermore, the qualitative evidence presented by Study 3 provides noteworthy evidence of group study condition participants providing (and receiving) social support from one-another during computer game play sessions as well as using their mutual computer game play as opportunities for socialisation. Specifically, Theme 1, sociability of computer game play, extensively documented the range of opportunity for social support and socialisation to occur through sociable computer game play.

As such, the research presented within this thesis has produced evidence to suggest that sociable computer game play can be facilitative of social support thereby providing an answer of yes to Research Question 1.

6.3.1.2. Research Question 2: does social support, potentially facilitated through sociable computer game play, in turn, facilitate self-efficacy?

From the performed NHST analysis the results do not indicate a clear case of sociable computer game play facilitating self-efficacy. If social support was facilitative of self-efficacy then it would be expected that the self-efficacy of the group study condition would be significantly different, and greater, to that of the solo study condition due to the presence of sociable computer game play and the subsequent facilitation of social support. This was not found to be the case, 3×2 mixed ANOVA and ANCOVA tests of the SEEHS and GSES in Studies 1 and 2, respectively, were statistically non-significant and their associated MBIs were in most cases inferred to be unclear with one inference of most likely to be trivial being made. In producing qualitative descriptors for the unclear inferences all instances appeared to be equally likely to be positive or negative with an effect range of small or trivial.

However, the performed mediation analyses can be examined to answer Research Question 2 by using the *a* pathway of the mediating model, which involves the predictor, social support (SSQN or SSQS), and the mediator, self-efficacy (SEEHS or GSES), and tests to confirm that the mediator is significantly associated with the predictor. With this approach, it can be seen that social support was facilitative of self-efficacy in Study 1 as the *a* pathway was statistically

significant and positive, indicating that as social support increased so did self-efficacy in the solo study condition with SSQS as the predictor. In Study 2, three instances of statistically significant *a* pathways were detected, one in the group study condition with SSQS as the predictor and for both SSQN and SSQS predictors in the solo study condition. Both of the significant cases with SSQS as the predictor were positive. This indicates that as social support increased as did self-efficacy. The statistically significant *a* pathway with SSQN as the predictor in the solo study condition was negative, suggesting that as social support increased, self-efficacy decreased, which was not expected.

As reported in Study 3 the identified Theme 2, social support facilitating a sense of self-efficacy, highlights participant's experience of an increased sense of confidence following sociable computer game play. Despite not being a strictly defined perception of increased self-efficacy as described by participants, it is possible that they what they experienced was akin to the concept of self-efficacy and merely articulated in terms that were more familiar to them.

As such, the performed research within this thesis provides evidence to suggest that social support is indeed facilitative of self-efficacy. Therefore, from the provided evidence an answer of yes to Research Question 2 can be given.

6.3.1.3. Research Question 3: does self-efficacy mediate a relationship between social support, potentially facilitated through sociable computer game play, and positive health-related behaviour?

In responding to Research Question 3 the performed mediation analyses need to be examined, in particular the indirect effect; the application of Zhao et al.'s (2010) typology of mediations and non-mediations was useful in determining where

mediation can be said to have occurred or not. Indirect-only mediation was detected in six of the 30 performed mediation analyses across Studies 1 and 2. Indirect-only mediation occurs when the $a \times b$ pathway (indirect effect) exists and c' (direct effect) does not, suggesting that mediation occurred and is consistent with the hypothesized theoretical framework (Zhao et al., 2010). In Study 1 indirect-only mediation was detected in the group study condition for the moderate-, vigorous-, and total physical activity outcomes with SSQS predicting the relationship. In Study 2 indirect-only mediation was detected in the group study condition with SSQS predicted the mediating relationship and in the solo study condition where SSQN and SSQS predicted the mediating relationship. In all instances of indirect-only mediation in Study 1, the indirect effect was negative suggesting that as satisfaction with social support increased the quantity of physical activity engaged in decreased. The b pathway in each of these instances was positive, indicating that as self-efficacy increased so did the quantity of physical activity. In all instances of indirect-only mediation in Study 2, the indirect effect was negative suggesting that as the quantity of social support increased the quantity of perceived stress decreased.

As such, the occurrence of indirect-only mediation in the above described instances provides evidence to suggest that a relationship between social support and the positive health-related outcomes of increasing physical activity and reducing perceived stress exists and is mediated by self-efficacy. Therefore, an answer of yes to Research Question 3 can be given.

6.3.2. Outcome of findings on research aims

Research Questions 1, 2, and 3 were formulated as tools to focus and direct the avenue(s) of inquiry within this thesis, following the specification of the research aims. Within this section, each of the established research aims are considered in relation to the research questions and findings of Studies 1, 2, and 3.

6.3.2.1. Research Aim 1: to investigate the capacity for computer games, through sociable game play, to elicit social support, self-efficacy, and positive health-related behaviour.

Research Aim 1 is a culmination of the theoretical framework that was adopted within this thesis as a product of the literature that was reviewed in Chapter 2. The theoretical framework is a logical and original arrangement of the psycho-social concepts social support, self-efficacy, and positive health-related behaviour change (increasing physical activity and reducing perceived stress); in which they form a mediation relationship and originate from sociable computer game play. Therefore, a prominent aim of this thesis is to investigate sociable computer game play as being facilitative of social support, self-efficacy, and positive health-related behaviour.

This aim was investigated by the performing of three experiments with the objective to establish whether or not sociable computer game play had the capacity to elicit social support, self-efficacy, and positive health-related behaviour. Due to the study design used in the experiments involving three participant study conditions, group, solo, and control, and conducting the interventions over an extended period of time, the differences between sociable computer game play,

computer game play, and the absence of computer game stimulus were effectively established.

Through 3×2 mixed ANOVA and ANCOVA, which were supplemented with MBI, mediation analysis, and a top-down theoretical thematic analysis, the presented findings within this thesis provide evidence to suggest that sociable computer game play is facilitative of social support, self-efficacy for exercise, and increasing physical activity, in the case of Study 1, and social support, generalised self-efficacy, and reducing perceived stress, in the case of Studies 2 and 3. Therefore, the performed investigations and their respective findings are sufficient to have met the requirements stipulated in Research Aim 1.

6.3.2.2. Research Aim 2: to investigate if sociable computer game play can be used as a therapeutic tool across a range of health outcomes.

Research Aim 2 is concerned with the role that sociable computer game play may have in benefiting or ameliorating a range of health-related behaviours. The purpose of this was to establish whether or not sociable computer game play could be utilised as an effective therapeutic tool, which would be of significant interest to healthcare practitioners and, more broadly, health psychology. This is due to the established broad prevalence of computer gaming technology within the UK and its relative affordability, which was described in Section 2.2.3. If it can be established that sociable computer game play can be facilitative of health-benefitting qualities such as social support, and self-efficacy then it could potentially be utilised as a cost-effective therapeutic tool.

The findings from 3×2 mixed ANOVA and ANCOVA in Studies 1 and 2 have provided evidence to support the use of sociable computer game play as a

therapeutic tool in terms of being beneficial to social support and increasing levels of physical activity. However, inferential analysis using 3×2 mixed ANOVA and ANCOVA in Studies 1 and 2 did not indicate sociable computer game play to be beneficial in increasing self-efficacy or in reducing perceived stress in Study 2; however, sociable computer game play did not appear to be harmful to these outcomes either. Study 3, on the other hand, did provide valuable qualitative data following participant's engagement in sociable computer game play, where it appeared that participants experienced beneficial effects upon their perceived stress and potentially their self-efficacy.

As such, further research is needed to provide a more definitive account of sociable computer game play's effect upon self-efficacy. Despite this, a thorough investigation of the therapeutic benefits of sociable computer game play has been conducted and has yielded noteworthy findings regarding the impact sociable computer game play may have upon social support, self-efficacy, physical activity, and perceived stress, thereby satisfying Research Aim 2.

6.3.2.3. Research Aim 3: to investigate the mechanism of action on positive health-related behaviour from social support and self-efficacy.

Research Aim 3 specifies an interest in the mechanisms of action between positive health-related behaviour, social support, and self-efficacy. As such, identifying a model to explain how these concepts are associated is of significant interest. In order to investigate the associations between social support, potentially derived from sociable computer game play, self-efficacy, and positive health-

related outcomes, increasing physical activity and reducing perceived stress, a mediation model was formulated.

Mediation analysis was used to investigate for associations between social support, self-efficacy, and positive health-related behaviour in order to establish in what way the investigated psycho-social concepts might interact. The identification of indirect-only mediation has provided evidence to support the conceptualisation of the factors under investigation in a mediating relationship in which social support predicts positive health-related behaviour and is mediated by self-efficacy. As such, the research presented within this thesis has identified a mechanism in which social support and self-efficacy contribute to positive health-related behaviour, thereby satisfying Research Aim 3.

6.3.3. Benefits of utilising quantitative and qualitative evidence.

The research presented within this thesis can be described as being quantitatively dominant mixed methods research, as described by Johnson, Onwuegbuzie, and Turner (2007), due to the qualitative information provided by Study 3 being supplemental to the findings of the exclusively quantitative Studies 1 and 2. There are a number of benefits in conducting mixed methods research; primarily it provides the opportunity to capitalise on the respective strengths that quantitative and qualitative research methods offer. The investigation of sociable computer game play as being facilitative of positive health-related behaviour change using a mixed methods approach has provided additional rigour and impact to the provided evidence over that of an exclusively quantitative or qualitative approach. Furthermore, in including different forms of collected data any connections or potential contradictions between the quantitative and qualitative evidence can be

explored (Shorten & Smith, 2017). An example of this can be seen when comparing the outcomes of 3×2 mixed ANOVA and ANCOVA from Study 2 to the findings of the thematic analysis presented in Study 3. Quantitative evidence suggests that the group study condition participants did not experience a statistically significant increase in their social support, self-efficacy, or a reduction in their perceived stress compared to solo study conditions. However, the performed thematic analysis provides contradictory information in which the group study condition participants clearly articulated a perception of experiencing social support and positive socialisation between the members of the ‘team’ during their mutual computer game play, as well as increased feelings of confidence, and reduced perceived stress.

6.3.4. Application of findings to literature.

Within the academic literature that has investigated computer games and their capacity for social play, it is widely documented that they are facilitative of social support (Cole & Griffiths, 2007; Collins & Cox, 2014; Dengah et al., 2018; Ducheneaut & Moore, 2006; Jansz & Tanis, 2007; Lindley et al., 2008; Longman et al., 2009; Macvean & Robertson, 2013; Mueller & Gibbs, 2010; O’Connor et al., 2015; Park et al., 2011; Perry et al., 2018; Reinecke, 2009a, 2009b; Staiano et al., 2013; Stenros et al., 2009; Trepte et al., 2012; Westwood & Griffiths, 2010; Williams et al., 2006; Williams et al., 2008; Yee, 2006a, 2006b). The findings provided from Studies 1, 2, and 3 are corroborative with previous studies as it was found, as expected, that sociable computer game play is facilitative of social support.

Studies 1 and 2, however, measured social support as two concepts, the quantity of available social support (SSQN; received social support) and the satisfaction with social support (SSQS; perceived social support). This presents the opportunity to identify if differences exist between the two concepts of social support; specifically, if either are more likely to be produced from sociable computer game play and if either are more effective in facilitating positive health-related behaviour change.

Across Study 1 and Study 2, SSQS appeared to be more prominently represented as a product of sociable computer game play and in predicting the mediating relationship between social support, self-efficacy, and positive health-related behaviour. In Study 1, following 3×2 mixed ANOVA, SSQS was mechanistically inferred as likely to be positive and clinically as likely beneficial and very unlikely harmful. Following ANCOVA, SSQN was mechanistically inferred as likely to be positive and clinically as likely beneficial and very unlikely harmful. In Study 2, 3×2 mixed ANOVA and ANCOVA revealed statistically significant effects of SSQN. However, they were not in the predicted direction and as such were inferred to be negative/harmful. Following ANCOVA, the effect of SSQS was considered to be mechanistically trivial with a clinical inference of likely beneficial and very unlikely harmful; use. Mediation analysis revealed an increase in SSQS to significantly predict a reduction in perceived stress for both the group and solo study conditions; this was found to be the case for SSQN in the solo study condition.

These findings provide support to the reviewed literature concerning the importance of perceived social support over received social support. As Uchino (2009) described and is depicted in Figures 2.6. and 2.7., the perception of social support influences an individual's appraisal of their environment, thereby helping

to prevent or reduce any negative effects from stressful stimuli which contributes to good health. On the other hand, received social support provides enhanced coping performance, thereby mitigating the impact of stressful events on health. Because of this distinction between perceived and received social support the findings of Study 1 and 2 also suggest that the buffering hypothesis of social support on stress may be a more effective explanation of how social support contributes to psychological and physiological good-health. The buffering hypothesis explains that social support buffers an individual from the deleterious effects of stressful life events by acting as an exploitable resource and, as such, is reactive rather than proactive to stimuli. The reviewed literature suggests the perceived social support is more predictive of the stress-buffering function of social support than received social support (Uchino, 2009; Wethington & Kessler, 1986). As such, it is conceivable that this was the case in Studies 1 2, and potentially, 3 in which the relationship between perceived social support and positive health-related behaviour was identified and was mediated by self-efficacy. An increase in perceived social support may have provided participants with sufficient coping resources to then engage in positive health-related behaviour such as increasing their physical activity or to help them cope more effectively with stress leading to a reduction in perceived stress.

The duration of eight weeks for the interventions in both Studies 1 and 2 was informed by a variety of related academic literature both within the area of computer game research on health outcomes and other non-computer game-based health interventions. Examples include Eather et al. (2013) and Rackow et al. (2015) who each used eight-week durations for interventions using the 'Fit-4-Fun' physical activity program for primary school children, and the effect of new

sports companions on received social support and physical exercise, respectively. Macvean and Robertson (2013) conducted a seven week intervention which investigated the use of exergames in relation to longitudinal patterns of user's physical activity, motivations, and behaviour. Staiano et al. (2013) conducted a 20 week intervention study investigating adolescent exergame play and weight loss. As such, a duration of eight weeks for both interventions appeared to be appropriate, especially so in considering the sample population of Studies 1 and 2. As previously described in Sections 3.5.1.1. and 4.5.1.1. postponement of the intervention had to occur in certain circumstances, such as between university semesters, which over the course of eight weeks would occur at most once.

A limitation of Studies 1 and 2 was the unclear effect of sociable computer game play upon self-efficacy. It was expected that following sociable computer game play beneficial effects to self-efficacy would occur, 3×2 mixed ANOVA, ANCOVA, and supplementary MBI do not appear to support this. A potential explanation for this is that of the effect the intervention had on social support. As identified in Chapter 2, social support and self-efficacy appear to be associated together, with social support typically predicting self-efficacy (Bandura, 1997; Duncan & McAuley, 1993; Faridvand et al., 2017; Resnick et al., 2002). It is possible that the beneficial effects of sociable computer game play on SSQN and SSQS that were detected in Study 1 may not have been sufficiently large enough to, in turn, produce a beneficial and detectable effect upon self-efficacy. In comparing the group and solo study conditions at week eight of the intervention the difference in average SSQN was 0.8 (group $M = 4.61$, $SD = 1.93$; solo $M = 3.81$, $SD = 2.13$) and SSQS was 0.46 (group $M = 5.51$, $SD = 0.57$; solo $M = 5.05$, $SD = 0.94$)

suggesting that although beneficial effects on social support occurred following sociable computer game play the beneficial effects were in fact moderate.

Upon closer examination of the MBIs performed with self-efficacy (SEEHS or GSES) as the dependent variable, it can be seen that there were no instances where this variable was considered to be outright negative/harmful. In Study 1, following 3×2 mixed ANOVA, SEEHS was considered to be equally probable of being positive or negative, 27.4% vs 28.9% respectively, and following ANCOVA it was probabilistically certain to be trivial. In Study 2, following both 3×2 mixed ANOVA and ANCOVA sociable computer game play was probabilistically more likely to have a positive effect on GSES score than a negative effect, 38.6% vs 17.4% and 33.9% vs 9%, respectively. Despite the larger probability of sociable computer game play to have a positive effect upon GSES score the probability of a negative effect was considered too high. This provides some evidence to suggest that sociable computer game play produced the expected effect on self-efficacy in both studies, especially so, in Study 2.

Study 3 has also provided some additional information pertaining to the occurrence of self-efficacy following sociable computer game play, and an increase in social support. Participants within the group study condition did express belief regarding an increased sense of confidence towards the end of the investigation as well as that of social support. However, with the collected qualitative data, it is not possible to comment on the manner in which these constructs are associated within Study 3.

Self-efficacy was identified to be a statistically significant mediator during mediation analysis within both Studies 1 and 2, thereby providing support for the theoretical framework investigated within this thesis and the tested original

arrangement of concepts made possible from sociable computer game play. Due to the identification of self-efficacy as a significant mediator this suggests that it is associated with social support and, in turn, positive health-related behaviour.

Previous literature has identified the mediating role of self-efficacy across a range of behaviours such as flu vaccination (Ernsting et al., 2015), career exploration (Zhang & Huang, 2018), exercising with a companion (Rackow et al., 2015), and objective memory (Thomas et al., 2016). As such, the present thesis contributes information regarding the mediating role of self-efficacy in a novel association between social support from sociable computer game play and the health outcomes of increasing physical activity and reducing perceived stress.

In Sheeran et al.'s (2016) meta-analysis of 204 studies it was identified that experimentally induced changes in attitudes, norms, and self-efficacy were associated with medium-sized effects on changes in behavioural intention and small to medium-sized effects in behaviour. Study 1 and Study 2 included measurements of behaviour, increasing physical activity and reducing perceived stress. However, no measure of behavioural intention was used. This is a limitation of the performed research; if a measurement of behavioural intention was included further noteworthy information could have been gathered regarding the role of self-efficacy in health-related behaviour change.

In behaviour change research many interventions are designed around the various models of behaviour change such as the theories of reasoned action (Ajzen & Fishbein, 1980) or planned behaviour (Ajzen, 1991), the health belief model (Maiman & Becker, 1974), the transtheoretical model of behaviour change (Prochaska & DiClemente, 1983), and protection motivation theory (Rogers, 1983). Many of these models incorporate the psycho-social concepts of social

support and self-efficacy that were investigated within this thesis. However, the presented findings provide evidence to support an alternative arrangement of these psycho-social concepts. In addition, the presented findings provide relevant information regarding how social support and self-efficacy, which are typically found within models of behaviour change, are associated with one-another. Specifically, in the case of the present research, the mediation model has established a mechanism between social support and positive health-related behaviour that is mediated by self-efficacy. This highlights the importance of continued investigation and iteration of models that are predictive of behaviour change in order to further the development of knowledge in effective health-related behaviour change in humans.

The decision to use Wii Sports as the computer game that was engaged with in the group and solo study conditions in both Study 1 and Study 2 was made due to its' prevalence within the psychological literature (Adie et al., 2017; Bausch et al., 2007; de Carvalho et al., 2014; Dae-In et al., 2015; Graves et al., 2007; Haddock et al., 2010; Keogh et al., 2014; Naugle et al., 2017; Staiano & Calvert, 2011; Staiano et al., 2013), suggesting it to be an appropriate computer game for the purposes of the present studies as well as being easy to learn how to play it with minimal instruction needed. A further benefit to using the Wii Sports computer game was that it offered participants an element of choice and, therefore, self-determination in which they could choose which activity offered by Wii Sports they wished to engage with. This is an important benefit for an activity to provide in order to be facilitative of leisure states, as outlined in Iwasaki and Mannell's (2000) hierarchical model of leisure stress coping. As such, in both Study 1 and Study 2 participants were invited to choose from three activities offered by the Wii Sports

computer game to engage with, tennis, bowling, and golf. Further to enabling the ability to self-determine, it is possible that this choice in computer game activity may have delayed onset of boredom effects as participants were not restricted to one activity, a limitation identified in previous literature such as Staiano and Calvert (2011). Following Study 3 however, which provided evidence that this particular computer game caused some frustration and annoyance amongst participants suggests that Wii Sports was not a wholly ideal choice of computer game. Without the inclusion of qualitative evidence into the present thesis, this response to the chosen computer game would not have been detected.

Providing participants with the choice of computer game activity out of tennis, bowling, and golf does have associated limitations in terms of the loss of experimental control. This is due to participants potentially engaging in the three available activities differently, for example engaging in the tennis, bowling, and golf activities equally or choosing instead to exclusively engage in one of the available activities. As such, not explicitly controlling the computer game activity means that participants may have exposed themselves to differing computer game play experiences which could influence their responses to measurement.

Typically an unwanted influence, practice effects may have occurred over the eight week period of the intervention by participants becoming more proficient in engaging with the computer game. It is possible that this development in skill with the computer game has influenced game engagement and potentially offered additional avenues of sociability, especially within the group study condition. This argument can be supported by the supposition made by Stenros et al. (2009), who suggests that computer games may be inherently sociable through built-in systems such as that of scoring/point systems, for example. Therefore, as

participants developed their skills in playing Wii Sports, sociable interactions may have occurred through means of encouragement or competition, for example, thereby providing opportunities for the development of social relationships and consequently social support.

Study 3 has provided a broad range of information supporting the claims made in the previous two paragraphs. It appeared that solo study condition participants enjoyed creating their own competition by engaging in the same activities each week in an effort to practice and increase their proficiency, and therefore scored points, at the activity. On the other hand, group study condition participants appeared to prefer switching between the activities rather than focusing on any particular one. They did indicate a preference for the tennis and bowling activities over the golf activity due to perceived negative properties of the game mechanics within the golf activity.

Lastly, the potential for the occurrence of social facilitation that sociable computer game play may have facilitated must be considered within the context of the presented research. Social facilitation relates to the changes within an individual's behaviour, such as performance on a task, given the presence of others who can be real, imagined, or implied (Strauss, 2002). A large number of social facilitation theories exist, which attempt to provide explanations as to how the presence of others, as an audience or co-actors, can facilitate an improvement to performance or, alternatively, impede it.

One of the most noteworthy models within facilitation theory, the drive theory of social facilitation, was put forward by Zajonc (1965), who proposed that the presence of other individuals would increase the general drive and activation level of the actor. It is argued that the activation of the individual is an innate reaction

done so in preparation for potential unexpected behaviour by the other individual(s). Zajonc's (1965) theory explains that this activation increases the likelihood of a dominant reaction occurring over a subordinate reaction. A dominant reaction is considered a reaction to specific contextual stimuli and has priority over other reactions available to the individual, due to being the response with the greatest habit strength (Platanina & Moran, 2001). This is where performance on a task can be effected by the presence of others, for example in simple well-learned tasks the dominant reaction would typically be the correct response to make and is therefore beneficial. Conversely, in more complex and unfamiliar tasks, the dominant reaction is less likely to be the correct solution and is therefore harmful. See Fig 6.2., which presents Zajonc's model for clarity.

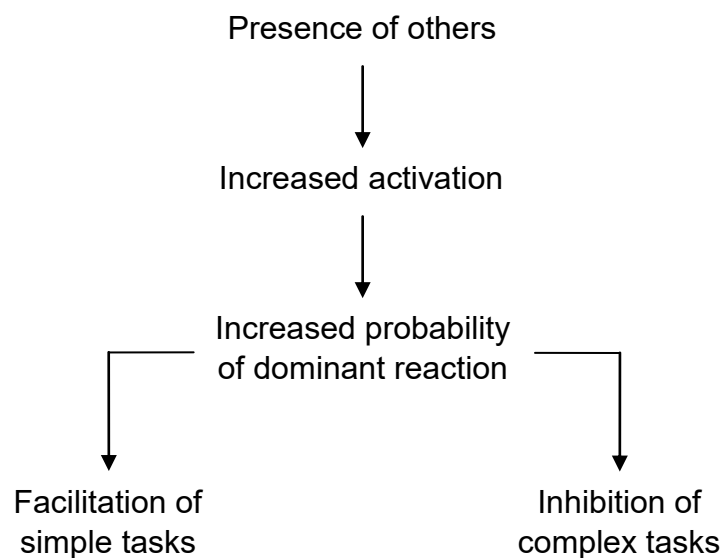


Figure 6.2. Zajonc's (1965) model of social facilitation, adapted from Strauss (2002).

Other models have attempted to provide further information to better explain social facilitation, such as suggesting that the increased activation in Zajonc's model occurs following an individual's association of their audience and/or co-actors with evaluations of their performance, for example. Zajonc's (1965) model has generated the most empirical evidence within the social facilitation literature and is

widely supported. A meta-analysis identified incremental benefits to performance in simple tasks using quantitative measurements and performance inhibition in complex tasks using qualitative measures (Bond & Titus, 1983).

As such, it is conceivable to expect that participants within the group study conditions of Studies 1, 2, and 3 who were exposed to sociable computer game play may have been influenced by the presence of other participants. Snyder, Anderson-Hanley, and Arciero (2012) conducted an investigation into examining the difference between a virtual and a real competitor during a virtual reality exergame activity. They identified that the presence of a real competitor yielded better performance, increased exercise intensity, on the exergame task in comparison to a simulated competitor. However, this relationship was found to be moderated by competitiveness, in that participants who were identified as being more competitive responded by exercising more intensely within the presence of a live competitor when compared to a virtual competitor. Participants who were not as competitive did not increase their exercise intensity significantly when paired with a real competitor in comparison to a simulated one.

Other investigations into the function of social facilitation during computer game play include Kimble and Rezabek (1992) who compared skilled and unskilled computer game players across simple (Pinball) and complex (Tetris) computer games. It was predicted that, following social facilitation theory, when observed by an audience skilled players would perform better and unskilled players would perform worse, furthermore all players would perform better during the simple computer game and worse during the complex computer game. Results indicated that the skilled players performed worse and unskilled players performed better when observed by an audience during the simple computer game. Additionally,

during complex computer game play under audience observation both the skilled and unskilled players performed worse. Bowman, Weber, Tamborini, and Sherry (2013) conducted a study using a 2×2×2 factorial design in which audience presence (isolation or audience), player skill (skilled or unskilled) and game challenge (high or low) were included as factors. Their findings support the conceptualisation of social facilitation as present in Zajonc's (1965) model in which it was found that during low game challenge computer game play the presence of an audience beneficially effected performance for both skilled and unskilled participants. However, audience presence did not appear to affect high challenge computer game play performance.

The studies conducted by Kimble and Rezabek (1992) and Bowman et al. (2013) are not directly comparable to the research that is presented within this thesis however. This is because neither investigation studied the presence of an audience who are also engaging in the computer game play as competitors or co-actors. It is likely that a passive audience and active competitors may potentially interact with each other in different ways. However these investigations, Snyder et al. (2012), Kimble and Rezabek (1992), and Bowman et al. (2013), do provide valuable evidence to suggest that social facilitation may have been a worthwhile consideration for measurement during Studies 1, 2, and 3. As such, the presented research makes an assumption that sociable computer game play would be facilitative of social support and, by extension, self-efficacy and positive health-related behaviour change. However, the presented social facilitation literature suggests that due to individual differences some participants within the presented research may have found that the sociable computer game play may have been

inhibitory to their computer game performance as well as potentially their perception of social support, self-efficacy, and perceived stress.

6.3.5. Contribution to scientific knowledge.

The original contributions to scientific knowledge that have been made by the research that is presented within this thesis are stated here.

6.3.5.1. The application of Iwasaki and Mannell's (2010) hierarchical model of leisure stress coping.

As previously outlined in Section 2.3.5., Iwasaki and Mannell's (2010) hierarchical model of leisure stress coping was conceptualised to explain how engagement, and the motivation to do so, in leisurely activities produces stress-coping resources, in the case of leisure coping beliefs, and stress-coping behaviour, in the case of leisure coping strategies. The present research was interested in this model due to the leisure friendships and leisure companionship sub-dimensions, which represent social support as an integral component of leisure where individuals pursue leisure participation in order to derive social support resources. As such, the application of Iwasaki and Mannell's (2010) hierarchical model of leisure stress coping is original and provides a sound theoretical basis for sociable computer game play to be facilitative of social support and consequently act as an effective therapeutic tool for fostering positive health-related behaviour(s).

6.3.5.2. The arrangement of social support, self-efficacy, and positive health-related behavioural outcomes in a mediating relationship initiated by sociable computer game play.

A number of previous investigations have examined the relationships between social support, self-efficacy, and their associations with a variety of positive health-related behaviours. However, the application of sociable computer game play in a longitudinal (eight week) intervention programme to facilitate social support and, in turn, positive health-related behaviour through the identified mechanism is unique. Using Iwasaki and Mannell's (2010) hierarchical model of leisure stress coping to outline how sociable computer game play is facilitative of social support adds to the uniqueness of the arrangement of concepts that formed the research model under investigation within this thesis (Figure 2.12. and 5.1.). The evidence presented within this research demonstrates the role that sociable computer game play may have in facilitating positive health-related behaviour. This is advantageous to health psychology and society as a whole due to the relative ease of access that this technology offers, in terms of cost and current prevalence within the UK.

6.3.5.3. The establishment of sociable computer game play as a therapeutic tool across different health-related outcomes.

In reviewing the related academic literature involving sociable computer game play, social support, and health outcomes it can be seen that singular health outcomes were measured as the focus of each investigation. For example, Staiano et al. (2013) investigated weight loss following pair-based sociable computer game play, Macvean and Robertson (2013) were interested in the use of

a GPS mobile phone-based computer game for increasing physical activity in children, and Choi et al. (2014) investigated the use of an exergame designed to increase engagement in swimming for exercise. In testing the proposed research model across two distinct health outcomes, increasing physical activity and reducing perceived stress, significant evidence has been produced providing support and increased confidence in the original arrangement of concepts tested within this thesis. Had only one health behaviour outcome been investigated, as is common in the related academic literature, then it would not be possible to determine if the research model, and consequently sociable computer game play as a therapeutic tool, was an effective method that could be used to promote better health.

6.3.5.4. The application of magnitude-based inference within the context of health psychology research.

The use of MBIs within this thesis is not unique, it is an analytical tool that has been used for a number of years, typically within sport- and exercise science with arguments being made for its uptake in the behavioural sciences and psychology as well (van Schaik & Weston, 2016). The use of MBIs in this thesis' health psychology-oriented experiments appears to be unique, especially so, in the case of sociable computer game play based research. It is hoped that using progressive statistical methods, such as MBI, might encourage researchers in other scientific fields to consider their use in addition to traditional NHST analytical techniques. This will have a number of benefits including moving away from the reductive dichotomy of thought that NHST often leads to where an effect is considered to be either important or not depending on the specific value of p (Cumming, 2014). As Batterham and Hopkins (2005) described, the interpretation of significance values

at $p < .05$ produces little information. An outcome of $p < .05$ may not be useful in practice and, conversely, an outcome that is $p > .05$ may represent an effect that is worthwhile, but would typically be dismissed as unimportant. MBI provides the opportunity to provide meaningful rich information regarding the magnitude of the effect (negative/harmful, negligible/trivial, or positive/beneficial), which is supplemented with appropriate and meaningful qualitative statements.

6.3.5.5. Novel elements of study design.

In designing each of the studies presented within this research there was a need to separate the effect of sociable computer game play and any effect that computer game play itself may have upon the factors that were measured. In order to achieve this, the solo study condition was implemented, in addition to the group and control study conditions. This way, the study design provided the opportunity to make comparisons between sociable computer game play and game play alone whilst fulfilling the requirement of including a control group as well as allowing for baseline comparisons to be made. To the author's knowledge, this is a novel design.

6.4. Limitations of the research

In the process of conducting the research that is presented within this thesis, three experimental investigations have been performed. Each study was carried out in a rigorous manner in an effort to minimise error, by the application of appropriate designs and effective analytical methods. However, it is important to acknowledge the limitations present within this research so that future research may build upon the presented findings.

In using a laboratory setting to conduct the experiments it was possible to exert greater control on the environment and stimuli that participants were exposed to. However, a laboratory environment is capable of producing unintended behavioural outcomes, mostly as a result of demand characteristics, in which participants form their own interpretations regarding the purpose of the study and consequently might modify their behaviour as a result. This applies in particular to the samples that were recruited in Study 1 and 2, as these were predominantly comprised of university students. Certain demand characteristics may be more prominent in this population, as a result of their education, and it is conceivable that, through word-of-mouth, information about the study from participants was circulated to prospective participants, thereby influencing their decision to participate and what to expect from the study.

The 30-minute duration of computer game play was informed through previous research using computer games (Haddock et al., 2010; Mueller & Gibbs, 2010; Staiano & Calvert, 2011; Staiano et al., 2013), feedback from the piloting of Study 1's method (Section 3.3.5.), and convenience for the sample population.

Supporting the duration of computer game play used in the cited literature and the present research O'Brien and Mueller (2007) found that the average duration of exercise within their study was approximately 34 minutes, which is of relevance as the computer games that were used were exergames. However, limiting computer game play time to a 30-minute period at each laboratory visit is artificial and not representative of typical computer gaming habits. Average gaming time has been found to vary between an hour three-to-five times per week (Macvean & Robertson, 2013) to two hours several times per week (Reinecke, 2009a). The typical amounts of time engaged in computer game play increases for online-

based computer games which are typically associated with expectations of social play with average weekly hours of gaming being between 13 hours and as much as 44 hours (Longman et al., 2009; Sherry et al., 2013; Williams et al., 2008; Yee, 2006a).

The literature suggests that individuals are more likely to engage in longer computer game play when playing sociably (Ducheneaut & Moore, 2006; Jansz & Tanis, 2007). Therefore, it is possible that participants were unsatisfied with the amount of time allowed within the studies for sociable computer game play or were potentially frustrated if game time expired during an exciting moment. A number of instances where this appeared to happen occurred when participants, upon being informed that their 30 minute computer game play time had expired, indicated a desire to continue playing or to finish their current game. This was not a point of view that was expressed during the semi-structured interviews or focus groups in Study 3, however.

The manner in which participants were assigned to the group study conditions in both Studies 1 and 2 is potentially limited due to quasi-randomisation. The rigorous data-screening processes performed and tests conducted determining that both data sets met the required parametric assumptions helped to alleviate some of the concerns that quasi-randomisation can produce. However, in assigning participants to the group study condition there was some loss in experimental control as it is conceivable that some individuals participated together with friends or acquaintances and other participants may have participated with strangers. It is possible that those with pre-existing social relationships may have derived the psycho-social benefits of sociable computer

game play differently from those who were initiating in new social relationships facilitated through sociable computer game play.

Lastly, because there were instances where more than one inferential test was conducted on a singular hypothesis there is an elevated probability of a Type I error having occurred, this is known as familywise error. This occurs as the typically accepted alpha level of .05 presents a 5% probability of a Type I error occurring, in conducting multiple tests related to the same hypothesis this 5% probability of making a Type I error occurs multiple times, making it more probable to occur.

As such, Field (2017) suggests utilising the Bonferroni correction to counteract an increase in committing Type I error occurring due to familywise error. This is done by dividing α , typically .05, by the number of comparisons that were made. The Study 1 hypotheses that have been affected by this are H_{1a} , H_{1c} , H_{2a} , and H_{2c} . Hypotheses H_{1a} and H_{2a} , involved two comparisons and therefore have been re-assessed at $\alpha = .025$. Hypotheses H_{1c} and H_{2c} involved three comparisons but were initially tested at $\alpha = .025$ in the case of vigorous-intensity and total physical activity in 3x2 mixed ANOVA (affecting H_{1c}) and vigorous intensity physical activity in ANCOVA (affecting H_{2c}) to account for heterogeneity of the sample and as such these tests have been re-assessed at $\alpha = .008$. The application of adjusted α values to comparisons at risk of increased Type I error due to familywise error did not result in any cases of statistically significant findings being re-evaluated as statistically non-significant.

The Study 2 hypotheses that have been affected by this are H_{4a} and H_{5a} , which each involved two comparisons and were also tested at $\alpha = .025$ during 3x2 mixed

ANOVA to account for sample heterogeneity and as such these tests were re-assessed at $\alpha = .008$ for hypothesis H_{4a} . Hypothesis H_{5a} was re-assessed at $\alpha = .025$ due to acceptable sample homogeneity in ANCOVA. The application of adjusted alpha values to comparisons at risk of increased Type I error due to familywise error resulted in a statistically significant finding being re-evaluated as statistically non-significant. This occurred for the comparison made between the group and solo study conditions when SSQN was included during 3x2 mixed ANOVA. The effect of the adjusted alpha levels and the consequential re-classification of the statistical significance of the described comparison, however, do not provide sufficient evidence to alter the rejection of H_{4a} . However, it does provide some evidence to suggest that solo activity may not have had the observed beneficial effect upon SSQN score as initially reported.

Despite this, it was beneficial to consider the potential impact of familywise error and the resulting increase in probability of committing Type I errors within both studies. In re-assessing the affected comparisons doing so has improved the trustworthiness of Study 1 and 2's findings.

6.5. Future avenues of inquiry

Following the identification of the present thesis' limitations there are a number of improvements or modifications that could be implemented in future studies designs that are looking to build upon this research. A field-based study in the domestic environment would be one option for further research. The benefits of using such a design would be the ability to investigate the role of sociable computer game play in a 'normal' computer game playing environment between friend or family groups. This would provide valuable information regarding the

capacity for sociable computer game play to elicit social support to individuals already familiar with one another. A limitation of this would be the loss of experimental control due to not having control over the study's environment and existing social support among team members. Furthermore, in such a study compelling data might be gathered if rather than implementing a specified amount of computer game time participants could choose how long to engage in sociable computer game play for. These changes, conducting the study in a home environment, with friend or family groups, and game sessions to last for as long as desired may provide the appropriate conditions for social support to be derived from sociable computer game play, and in positive health-related behaviour change that is mediated by self-efficacy.

The research presented in this thesis successfully identified the role in which sociable computer game play can contribute to positive health-related behaviour change. As such, an obvious next step would be to broaden the scope of behaviours that are under investigation in order to determine if the research model used within this thesis can successfully promote other positive health-related behaviours. An example might include weight loss, which may possibly occur as a consequence of increased physical activity from sociable computer game play. Alternatively, focusing future investigations on the sociable computer game used may also provide to be a valuable line of inquiry. The present thesis identified some differences between how some computer games are played such as co-operative vs competitive as well as parallel vs non-parallel. The role of genre and method of interaction, such as between controllers or body movement, provides the opportunity for worthwhile investigation using the same research design as was used in Studies 1, 2, and 2.

The methods that have been used in the research presented in this thesis are suitable for replication in subsequent study, this may be potentially insightful and worthwhile in doing as computer gaming technology continues to develop. For example, virtual and augmented reality technologies have entered the mainstream computer game market, with little scientific literature investigating the potential therapeutic role that such technology may be capable of facilitating. It is possible that the improved immersive experience that this technology can offer may provide appropriate conditions that are facilitative of positive health-related behaviour. With networking technology it is common place now for computer gaming hardware to be capable of networking with other, non-co-located, hardware, thereby connecting computer gamers around the globe. Investigating if similar health behaviour outcomes could be facilitated through non-co-located sociable computer game play may prove to be a fruitful line of inquiry to pursue.

6.6. Closing statements

The purpose of this chapter was four-fold, firstly to document the potential impact of Studies 1, 2, and 3 on the broader psychological literature, secondly to provide a concise summary of the original contributions to scientific knowledge made by this thesis, thirdly to provide a reasonable account of the limitations associated with each of the presented investigations, and fourthly to provide commentary regarding potentially valuable future avenues of inquiry that have been made available by this thesis.

The findings from the current thesis provide evidence to suggest that sociable computer game play can be used as an effective therapeutic tool for the purposes of increasing physical activity and reducing perceived stress. The presented

evidence suggests that a mechanism in which this may occur is a mediating one, in which increased physical activity and reduced perceived stress are predicted by social support, which is derived from sociable computer game play, and mediated by self-efficacy.

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Appendix A₁ - Information sheet for group and solo study conditions (Study 1)

PARTICIPANT INFORMATION SHEET

Study Title: Eliciting positive behavioural change through self-efficacy as a consequence of social support experienced from computer-game play.

*I would like to invite you to take part in a research study. Before you decide I would like you to understand why the research is being done and what it would involve for you. **I will go through the information sheet with you and answer any questions you have.** This should take about 5 minutes. Talk to others about the study if you wish. Please ask if there is anything that is not clear.*

A large focus of today's health research revolves around lifestyle habits and behaviours of individuals and how we might modify these using technologies in order to encourage positive health-related behavioural change. It is thought that the concepts of social support and self-efficacy are significant in facilitating such behavioural change therefore, it is important to determine to what extent technologies such as computer-games may impact these.

What is the purpose of the study?

This study wants to find out about how computer games may facilitate social support and self-efficacy in individuals.

Why have I been invited?

You have been invited to take part because you have volunteered to participate.

Do I have to take part?

It is up to you to decide to join the study. I will describe the study and go through this information sheet. If you agree to take part, I will then ask you to sign a consent form. You are free to withdraw from the study at any time and can ask for your data to be destroyed up until (01/08/2016) without giving a reason.

What will happen to me if I take part?

After reading this document you will be asked to sign a consent form, this indicates that you are giving your fully-informed consent to participate in the study and that you acknowledge that you are aware of your rights as a participant in Psychological research.

Once this is done you will be given a participant demography questionnaire to complete, this will simply record your age, gender and typical exercise habits. You will also be asked to complete a Short Form Social Support Questionnaire and the Exercise Confidence Survey.

Once you have completed these, you will be asked to engage with the computer-game Wii Sports for 30 minutes, instructions for how to play this game can be found in the standardised instructions document that you have also been given.

Once computer-game play has finished you will be asked to complete a second Short Form Social Support Questionnaire and Exercise Confidence Survey.

Once these have all been completed the experiment will end. However, due to the nature of this research being longitudinal **you will be required to return to the laboratory once on a weekly basis** to engage in the computer game and to complete subsequent administrations of the Short Form Social Support Questionnaire and the Exercise Confidence Survey for **8 weeks** (from now on you will only need to complete these after each game play session). The experimenter will arrange these appointments with you at the end of each week's experiment.

It is possible that you may be asked to participate in a follow-up measurement 2 months after your participation in this research. This is entirely voluntary and will only require the completion of 3 questionnaires.

What are the potential disadvantages and risks of taking part in this study?

It is expected that there are no risks or disadvantages to participating within this study.

What are the possible benefits of taking part?

It is hoped that this study will help to provide further insight into the use of computer-games in facilitating social support and self-efficacy in their users furthermore, it is hoped that such changes will help to promote positive health-related behavioural changes e.g. increasing physical activity.

What if there is a problem?

Any complaint about the way you have been dealt with during the study or any possible harm you might suffer will be addressed. If you have a concern about any aspect of this study, you should ask to speak to my Research Supervisor, Katherine Swainston who will do their best to answer your questions (contact details can be found below).

Will my taking part in the study be kept confidential?

Yes. I will follow ethical and legal practice and all information about you will be handled in confidence. All information which is collected about you during the course of the research will be kept strictly confidential, and any information about you will have your name and contact details removed so that you cannot be recognised.

What will happen to the results of the research study?

The data gathered during this study will be used for the purpose of contributing to the completion of a PhD. Additionally, when appropriate the data may be used within articles that will be published within scientific journals.

Who has reviewed the study?

Teesside University's ethics committee has reviewed and approved this study to be carried out, consequently it has been deemed to be safe and ethically sound for all individuals whom will be involved.

Contact for Further Information

Researcher: Jonathan Farnell J.Farnell@tees.ac.uk

Research supervisor: Katherine Swainston K.Swainston@tees.ac.uk

Appendix A₂ - Information sheet for control study condition (Study 1)

PARTICIPANT INFORMATION SHEET

Study Title: Eliciting positive behavioural change through self-efficacy as a consequence of social support experienced from computer-game play.

*I would like to invite you to take part in a research study. Before you decide I would like you to understand why the research is being done and what it would involve for you. **I will go through the information sheet with you and answer any questions you have.** This should take about 5 minutes. Talk to others about the study if you wish. Please ask if there is anything that is not clear.*

A large focus of today's health research revolves around lifestyle habits and behaviours of individuals and how we might modify these to encourage positive health related behavioural change. It is thought that the concepts of social support and self-efficacy are significant in facilitating such behavioural change. As a result of this it is important to measure these behaviours and lifestyles as well as social support and self-efficacy in order to gain a more in-depth understanding of them.

What is the purpose of the study?

This study wants to find out about people's behaviours and lifestyle choices in relation to their physical activity.

Why have I been invited?

You have been invited to take part because you have volunteered to participate.

Do I have to take part?

It is up to you to decide to join the study. I will describe the study and go through this information sheet. If you agree to take part, I will then ask you to sign a consent form. You are free to withdraw from the study at any time and can ask for your data to be destroyed up until (01/08/2016) without giving a reason.

What will happen to me if I take part?

After reading this document you will be asked to sign a consent form, this indicates that you are giving your fully-informed consent to participate in the study and that you acknowledge that you are aware of your rights as a participant in Psychological research.

Once this is done you will be given a participant demography questionnaire to complete, this will simply record your age, gender and typical exercise habits.

Next you will be asked to complete the Short Form Social Support Questionnaire (Sarason, Sarason, Shearin, & Pierce, 1987) and the Exercise Confidence Survey (Sallis, Pinski, Grossman, Patterson, & Nader, 1988).

Once these have all been completed the experiment will end. However, due to the nature of this research being longitudinal **you will be required to return to the laboratory once on a weekly basis** to complete subsequent administrations of the Short Form Social Support Questionnaire and the Exercise Confidence Survey for **8 weeks**. The experimenter will arrange these appointments with you at the end of each week's experiment.

It is possible that you may be asked to participate in a follow-up measurement 2 months after your participation in this research. This is entirely voluntary and will only require the completion of 3 questionnaires.

What are the potential disadvantages and risks of taking part in this study?

It is expected that there are no risks or disadvantages to participating within this study.

What are the possible benefits of taking part?

It is hoped that this study will help to provide a representative insight into the general population's behaviours and habits in relation to participating in physical activity. It is also hoped that the study will help to identify facilitators and barriers to such behaviour from social support and/or self-efficacy.

What if there is a problem?

Any complaint about the way you have been dealt with during the study or any possible harm you might suffer will be addressed. If you have a concern about any aspect of this study, you should ask to speak to my Research Supervisor, Katherine Swainston who will do their best to answer your questions (contact details can be found below).

Will my taking part in the study be kept confidential?

Yes. I will follow ethical and legal practice and all information about you will be handled in confidence. All information which is collected about you during the course of the research will be kept strictly confidential, and any information about you will have your name and contact details removed so that you cannot be recognised.

What will happen to the results of the research study?

The data gathered during this study will be used for the purpose of contributing to the completion of a PhD. Additionally, when appropriate the data may be used within articles that will be published within scientific journals.

Who has reviewed the study?

Teesside University's ethics committee has reviewed and approved this study to be carried out, consequently it has been deemed to be safe and ethically sound for all individuals whom will be involved.

Contact for Further Information

Researcher: Jonathan Farnell J.Farnell@tees.ac.uk

Research supervisor: Katherine Swainston K.Swainston@tees.ac.uk

Appendix B - Consent form (Study 1)

Participant number:**Version I - 10/04/2014****CONSENT FORM**

Title of project: Eliciting positive behavioural change through self-efficacy as a consequence of social support experienced from computer-game play

Researcher: Jonathan Farnell

Thank you for agreeing to take part in this research. In agreeing to participate you have the following rights and protections as laid down in the British Psychological Society's ethical guidelines.

- *Your participation is entirely voluntary*
- *Under no circumstances will your real names or identifying information be included in the reporting of this research.*
- *You may withdraw your data from this research at any point until 01/08/2016*
- *Nobody, except myself and my research supervisory team will have access to this anonymised material in its entirety.*

In agreeing to the terms of this consent form, participants should be aware that any anonymised material is solely for use in the current research project.

Please initial

I confirm that I have read and understood the participant information sheet datedversion (I) for the above study. I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily.

☐

I understand that my participation is voluntary and that I am free to withdraw at any time up until 01/08/2016, without giving any reason. To withdraw your data please contact the researcher at: J.Farnell@tees.ac.uk and state your participation number

☐

I agree to take part in the above study.

☐

Name of Participant

Date

Signature

Jonathan Farnell



Researcher

Date

Signature

1 for participant; 1 for researcher

Appendix C - Participant debrief (Study 1)

Date:

Version I - 13/05/2014

DEBRIEF

Title: *Eliciting positive behavioural change through self-efficacy as a consequence of social support experienced from computer-game play*

Researcher: Jonathan Farnell

Aim of research: *This research is aiming to test if computer-games can be used to encourage health-related positive behavioural change in individuals. Specifically it is hoping to achieve this through using computer-games as a focal point of community between groups of people, it is predicted that members of such a group will experience enhanced social support and self-efficacy as a direct result of communal computer-game play. Theoretical evidence suggests that social support and self-efficacy are significant contributors to successful health-related behavioural change in humans.*

I would like to emphasise that all information provided by yourself will be treated with strict confidentiality and under no circumstances will your name or any identifying characteristics be included in any subsequent reports or publications. If you have any further questions about this study I would be more than happy to assist and can be contacted via e-mail at:

J.Farnell@tees.ac.uk

Alternatively, my supervisor Katherine Swainston can be contacted via e-mail at:

K.Swainston@tees.ac.uk

You can withdraw your data from this study without giving a reason up until 01/08/2016 by contacting the researcher via the email address given above and quoting your participant number.

If you require further information about the health impact of physical inactivity and what benefits that you might expect from becoming more active, the NHS Choices website family contains a lot of useful information:

<http://www.nhs.uk/livewell/fitness/pages/fitnesshome.aspx>

Thank you for your participation

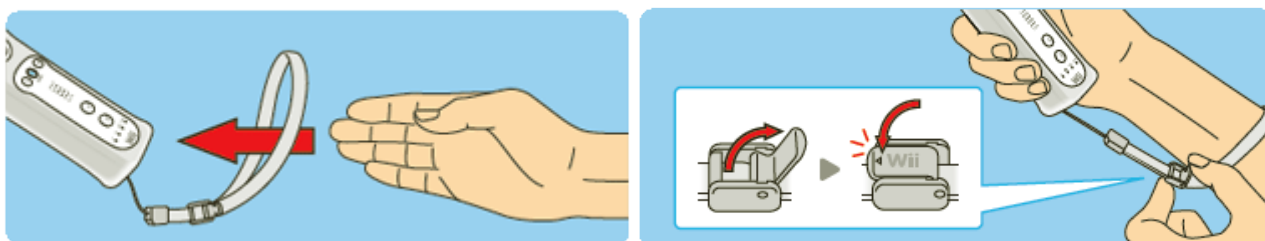
Appendix D - Standardised instructions for group and solo study conditions (Studies 1 & 2)

Wii Sports standardised instructions

Nintendo's Wii Sports game is a sport simulation game in which you can play a variety of different sports. To play this game you must physically move around, the controller (Wii remote) contains sensors that will detect your movement and it will allow you to move your character in the game.

Because Wii Sports requires players to emulate various sporting actions, such as hitting a Tennis ball there are some safety precautions that need to be in place in order to avoid injury to the user, others and the equipment.

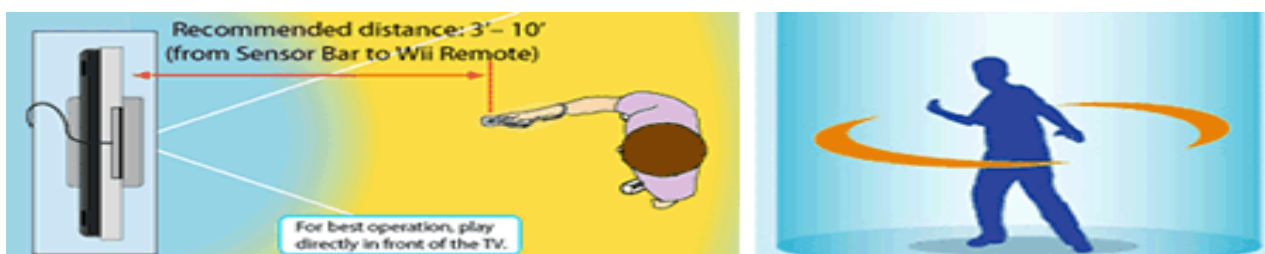
1. Ensure that you are using the wrist strap that is attached to the Wii remote and that it is securely tightened on your wrist, see pictures below for more information.



2. Ensure that you have plenty of room, whilst playing Wii Sports it is likely that you will be moving around as well as swinging your arm. Therefore it is important to make sure that you are not going to be playing too close to other individuals or objects. See pictures below for more information.

The Wii Sports game has 5 different sports that are available to play. However, in this experiment only the following sports are to be played:

- Tennis
- Bowling
- Golf



Instructions on how to play each of these games can be found on the following pages, thank you for taking the time to read these instructions. If you have any further questions feel free to ask the experimenter at any time.

Tennis (for 1 to 4 players)

This is a simplified doubles-style tennis game which can be played without pressing any buttons at all. All you need to do is swing the Wii Remote. You'll need a Wii Remote for each player.

The scoring consists of points and games only.

The first team to score four points wins the game, and the winning team is the first to win the set number of games.

How to hold the Wii Remote (if you are right-handed)

Grip the Remote as though it were a tennis racquet.



Note: Put the strap around your wrist and tighten the stopper to prevent it slipping off.

Note: Swing it gently.

Serving

Swing the Wii Remote upwards



Toss the ball

You can also toss the ball by pressing the A Button.

Swing the Wii Remote downwards at just the right moment



Hit the ball

Strokes

Watch the ball and move the Remote appropriately, swinging it on the right to hit a ball approaching on the right, and the left to hit a ball approaching on the left. By hitting in different ways, you can even hit lob and spin shots.



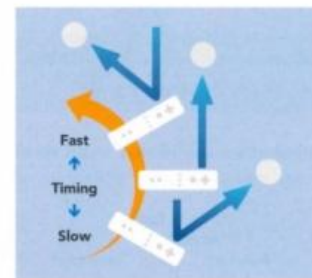
Forehand



Backhand

Hitting the ball to the left or the right

You can use the timing of your shot to determine the direction of the ball's trajectory.



Bowling (for 1 to 4 players)

You can use the Wii Remote to play a bowling game. You can even bowl curve balls. Up to four people can play this game, sharing one Wii Remote. Ten frames are played, and the winner is the player with the highest total score.

How to hold the Wii Remote (if you are right-handed)

Grip the Remote in your bowling hand.

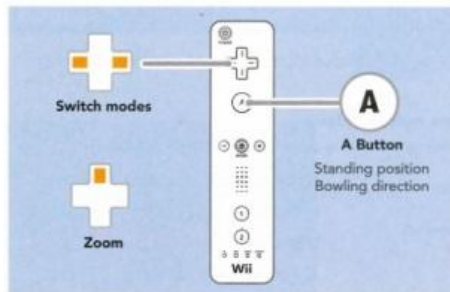


Note: Put the strap around your wrist and tighten the stopper to prevent it slipping off.

Note: Swing it gently.

Specifying Your Standing Position and Bowling Direction

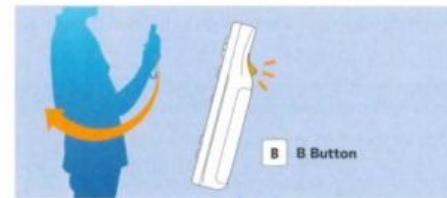
Use Left and Right to fix your standing position and bowling direction.



Press again the A Button to switch between the two modes.

Bowling a Ball

Holding down the B Button, assume the bowling stance with the Remote held in front of your chest, then take your arm back behind you...



...and swing it as though you were bowling a ball.

By twisting the Wii Remote, you can make the ball curve.



Golf (for 1 to 4 players)

This golf game lets you experience the feeling of wielding a golf club. Up to four players can play, sharing a single Wii Remote.

The winner is the player who completes the full complement of holes in the lowest number of strokes.

How to hold the Wii Remote (if you are right-handed)

Grip the Remote in both hands, as though it were a golf club.

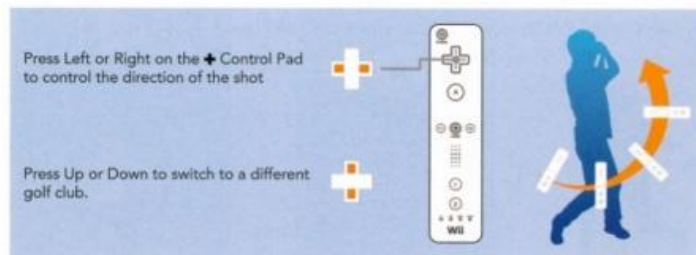


Note: Put the strap around your wrist and tighten the stopper to prevent it slipping off.

Note: Swing it gently.

Practising Your Swing

As you swing, keep the button side of the Wii Remote facing in the direction shown in the diagram.



If you swing too vigorously, you will miss the shot.

14



Taking a Swing for Real

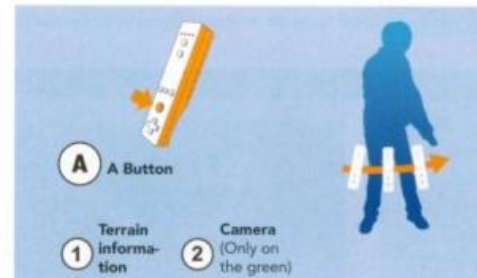
Holding down the A Button, swing the Wii Remote.



Grip the Wii Remote with its button side facing in the direction shown in the diagram.

Putting (on the green)

Holding down the A Button, swing the Wii Remote.



Grip the Wii Remote with its button side facing in the direction shown in the diagram.

Power Meter

When you hit a shot, the Power Meter will be displayed on the screen. If your swing registers 50 % on the Power Meter, the ball will fall at a point 50 % of the way along the predicted trajectory displayed on the course map on the right of the screen. (If the weather is windy, or if you are in the bunker or in the rough, the distance it travels will vary).

15

Appendix E - Participant demographic questionnaire (Study 1)

Date: _____

Participant number: _____

Demography questionnaire

Please answer the following questions:

1). Are you Male or Female? MALE FEMALE

2). How old are you? _____

3). On a weekly basis do you typically engage in more than 150 minutes of moderate-intensity aerobic activity or 75 minutes of vigorous-intensity aerobic activity?

YES NO

4). Do you actively engage in a physical activity group? E.g. a Football club.

YES NO

If yes, proceed to question 4b.

If no, proceed to question 5.

4b). Describe the physical activity group below.

5). Do you actively engage in physical activity on an individual basis?

YES NO

If yes, proceed to question 5b.

5b). Describe the physical activity that you engage in.

Thank you for answering the questions.

Appendix F - (SSQ6) Short Form Social Support Questionnaire (Studies 1 & 2)

Date: _____

Participant number: _____

Administration point: _____

Social Support Questionnaire (Short Form)

Instructions:

The following questions ask about people in your environment who provide you with help or support.

Each question has two parts. For the first part, list all the people you know, excluding yourself, whom you can count on for help or support in the manner described. Give the person's relationship to you (see example below).

For the second part, circle how satisfied you are with the overall support you have.

If you have had no support for a question, check the words "No one", but still rate your level of satisfaction.

Do not list more than nine persons per question.

Please answer all the questions as best you can. All your responses will be kept confidential.

Example:

Who do you know whom you can trust with information that could get you in trouble?

No one	1) Brother	4) Father	7)
	2) Friend	5) Employer	8)
	3) Friend	6)	9)

How satisfied are you with the support that you have?

6 - Very satisfied	5 - Fairly satisfied	4 - A little satisfied	3 - A little dissatisfied	2 - Fairly dissatisfied	1 - Very dissatisfied
-----------------------	-------------------------	---------------------------	------------------------------	----------------------------	--------------------------

1. Whom can you really count on to be dependable when you need help?

No one	1)	4)	7)
	2)	5)	8)
	3)	6)	9)

2. How satisfied are you with the support that you have?

6 - Very satisfied	5 - Fairly satisfied	4 - A little satisfied	3 - A little dissatisfied	2 - Fairly dissatisfied	1 - Very dissatisfied
-----------------------	-------------------------	---------------------------	------------------------------	----------------------------	--------------------------

3. Whom can you really count on to help you feel more relaxed when you are under pressure or tense?

No one	1)	4)	7)
	2)	5)	8)
	3)	6)	9)

4. How satisfied are you with the support that you have?

6 - Very satisfied	5 - Fairly satisfied	4 - A little satisfied	3 - A little dissatisfied	2 - Fairly dissatisfied	1 - Very dissatisfied
-----------------------	-------------------------	---------------------------	------------------------------	----------------------------	--------------------------

5. Who accepts you totally, including both your worst and your best points?

No one	1)	4)	7)
	2)	5)	8)
	3)	6)	9)

6. How satisfied are you with the support that you have?

6 - Very satisfied	5 - Fairly satisfied	4 - A little satisfied	3 - A little dissatisfied	2 - Fairly dissatisfied	1 - Very dissatisfied
-----------------------	-------------------------	---------------------------	------------------------------	----------------------------	--------------------------

7. Whom can you really count on to care about you, regardless of what is happening to you?

No one	1)	4)	7)
	2)	5)	8)
	3)	6)	9)

8. How satisfied are you with the support that you have?

6 - Very satisfied	5 - Fairly satisfied	4 - A little satisfied	3 - A little dissatisfied	2 - Fairly dissatisfied	1 - Very dissatisfied
-----------------------	-------------------------	---------------------------	------------------------------	----------------------------	--------------------------

9. Whom can you really count on to help you feel better when you are feeling generally down-in-the dumps?

No one	1)	4)	7)
	2)	5)	8)
	3)	6)	9)

10. How satisfied are you with the support that you have?

6 - Very satisfied	5 - Fairly satisfied	4 - A little satisfied	3 - A little dissatisfied	2 - Fairly dissatisfied	1 - Very dissatisfied
-----------------------	-------------------------	---------------------------	------------------------------	----------------------------	--------------------------

11. Whom can you count on to console you when you are very upset?

No one	1)	4)	7)
	2)	5)	8)
	3)	6)	9)

12. How satisfied are you with the support that you have?

6 - Very satisfied	5 - Fairly satisfied	4 - A little satisfied	3 - A little dissatisfied	2 - Fairly dissatisfied	1 - Very dissatisfied
-----------------------	-------------------------	---------------------------	------------------------------	----------------------------	--------------------------

Appendix G – (SEEHS) Self-Efficacy and Exercise Habits Survey (Study 1)

Date: _____

Participant number: _____

Administration point: _____

Exercise Confidence Survey

Below is a list of things people might do while trying to increase or continue regular exercise. We are interested in exercises like running, swimming, brisk walking, cycling, or aerobics.

Whether you exercise or not, please rate how confident you are that you could really motivate yourself to do things like these consistently, for at least six months.

	I know I cannot		Maybe I can		I know I can	Does not apply
1. Get up early, even on weekends, to exercise.	1	2	3	4	5	(8)
2. Stick to your exercise program after a long, tiring day at work.	1	2	3	4	5	(8)
3. Exercise even though you are feeling depressed.	1	2	3	4	5	(8)
4. Set aside time for a physical activity program for at least 30 minutes, 3 times per week. May include walking, jogging, swimming etc.	1	2	3	4	5	(8)
5. Continue to exercise with others even though they seem too fast or too slow for you.	1	2	3	4	5	(8)
6. Stick to your exercise program when undergoing a stressful life change (e.g., divorce)	1	2	3	4	5	(8)
7. Attend a party only after exercising.	1	2	3	4	5	(8)
8. Stick to your exercise program when your family is demanding more time from you.	1	2	3	4	5	(8)
9. Stick to your exercise program when you have household chores to attend to.	1	2	3	4	5	(8)
10. Stick to your exercise program even when you have excessive demands at work.	1	2	3	4	5	(8)
11. Stick to your exercise program when social obligations are very time consuming.	1	2	3	4	5	(8)
12. Read or study less in order to exercise more.	1	2	3	4	5	(8)

Appendix H - Self-report weekly physical activity questionnaire (Study 1)

Date: _____

Participant number: _____

Administration point: _____

Weekly physical activity

Please answer the following 4 questions, do not include any activity that you were required to engage in within the laboratory.

1). Over the past 7 days how much physical activity have you engaged in?

_____ minutes of moderate-intensity aerobic activity

_____ minutes of vigorous-intensity aerobic activity

Moderate-intensity activity will raise your heart rate and make you breathe faster and feel warmer. One way to tell if you're working at a moderate-intensity is if you can still talk, but cannot sing the words to a song.

Vigorous-intensity activity means you're breathing hard and fast, and your heart rate has gone up quite a bit. If you're working at this level, you won't be able to say more than a few words without pausing for breath.

2). If you have reported that you did engage in physical activity within the previous 7 days, how frequently did you do so?

☐ More than once a day

☐ Once a day

☐ Once every other day

☐ Once every few days

☐ Once

Thank you for answering these questions

Appendix I - Sampling distribution of F_{max} table and the interpolation equation used to calculate variance ratio critical values for $df = 14, 16, 17$, and 18 (Study 1)

Table I1

Sampling distribution of F_{max} table (Kanji, 1993).

Level of significance $\alpha = 0.05$

n - 1	k										
	2	3	4	5	6	7	8	9	10	11	12
2	39.0	87.5	142	202	266	333	403	475	550	626	704
3	15.4	27.8	39.2	50.7	62.0	72.9	83.5	93.9	104	114	124
4	9.6	15.5	20.6	25.2	29.5	33.6	37.5	41.1	44.6	48.0	51.4
5	7.15	10.8	13.7	16.3	18.7	20.8	22.9	24.7	26.5	28.2	29.9
6	5.82	8.38	10.4	12.1	13.7	15.0	16.3	17.5	18.6	19.7	20.7
7	4.99	6.94	8.44	9.70	10.8	11.8	12.7	13.5	14.3	15.1	15.8
8	4.43	6.00	7.18	8.12	9.03	9.78	10.5	11.1	11.7	12.2	12.7
9	4.03	5.34	6.31	7.11	7.80	8.41	8.95	9.45	9.91	10.3	10.7
10	3.72	4.85	5.67	6.34	6.92	7.42	7.87	8.28	8.66	9.01	9.34
12	3.28	4.16	4.79	5.30	5.72	6.09	6.42	6.72	7.00	7.25	7.48
15	2.86	3.54	4.01	4.37	4.68	4.95	5.19	5.40	5.59	5.77	5.93
20	2.46	2.95	3.29	3.54	3.76	3.94	4.10	4.24	4.37	4.49	4.59
30	2.07	2.40	2.61	2.78	2.91	3.02	3.12	3.21	3.29	3.36	3.39
60	1.67	1.85	1.96	2.04	2.11	2.17	2.22	2.26	2.30	2.33	2.36
∞	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

$$lower_{F_{max}} + \left[\left(\frac{actual_{df} - lower_{df}}{upper_{df} - lower_{df}} \right) \times (upper_{F_{max}} - lower_{F_{max}}) \right]$$

Figure I1. Equation for interpolating between known values of the sampling distribution of F_{max} table

$$4.16 + \left[\left(\frac{14 - 12}{15 - 12} \right) \times (3.54 - 4.16) \right] = 3.747$$

Figure I2. Equation example used to interpolate for a degrees of freedom value ($n-1$) of 14.

Table I2

Values needed to linearly interpolate Hartley's F_{max} variance ratio critical values ($k = 3$) for each df value included for inferential analysis in Study 1.

Actual df	Lower df	Upper df	Lower F_{max}	Upper F_{max}	Critical value
14	12	15	4.16	3.54	3.75
16	15	20	3.54	2.95	3.42
17	15	20	3.54	2.95	3.30
18	15	20	3.54	2.95	3.19

Appendix J - Smallest worthwhile change for each MBI comparison (Study 1)

Table J1

Study 1 pooled SD and smallest worthwhile effect for mixed 3×2 ANOVA MBI comparisons

Outcome variable	Comparison	SD pooled	Smallest worthwhile effect (0.2 x SD pooled)
SSQN	Solo vs Control	2.225	0.445
	Group vs Solo	2.039	0.408
	Group vs Control	2.138	0.428
SSQS	Solo vs Control	0.862	0.172
	Group vs Solo	0.789	0.158
	Group vs Control	0.663	0.133
Self-efficacy	Solo vs Control	0.647	0.129
	Group vs Solo	0.727	0.145
	Group vs Control	0.665	0.133
Moderate PA	Solo vs Control	53.849	10.770
	Group vs Solo	51.898	10.380
	Group vs Control	63.136	12.627
Vigorous PA	Solo vs Control	19.808	3.962
	Group vs Solo	35.975	7.195
	Group vs Control	38.191	7.638
Total PA	Solo vs Control	58.291	11.658
	Group vs Solo	68.675	13.735
	Group vs Control	76.875	15.375
PA frequency	Solo vs Control	1.321	0.264
	Group vs Solo	1.544	0.309
	Group vs Control	1.454	0.291

Table J2

Study 1 pooled SD and smallest worthwhile effect for ANCOVA MBI comparisons

Outcome variable	Comparison	SD pooled	Smallest worthwhile effect (0.2 x SD pooled)
SSQN	Group vs Solo	2.039	0.408
	Group vs Control	2.138	0.428
SSQS	Group vs Solo	0.789	0.158
	Group vs Control	0.663	0.133
Self-efficacy	Group vs Solo	0.739	0.148
	Group vs Control	0.665	0.133
Moderate PA	Group vs Solo	51.898	10.380
	Group vs Control	63.136	12.627
Vigorous PA	Group vs Solo	35.975	7.195
	Group vs Control	38.191	7.637
Total PA	Group vs Solo	65.377	13.075
	Group vs Control	76.875	15.375
PA frequency	Group vs Solo	1.544	0.309
	Group vs Control	1.454	0.291

Appendix K - 3×2 mixed ANOVA Interaction graph displaying the significant interaction between measurement time point for the frequency of physical activity dependant variable and study condition (Study 1)

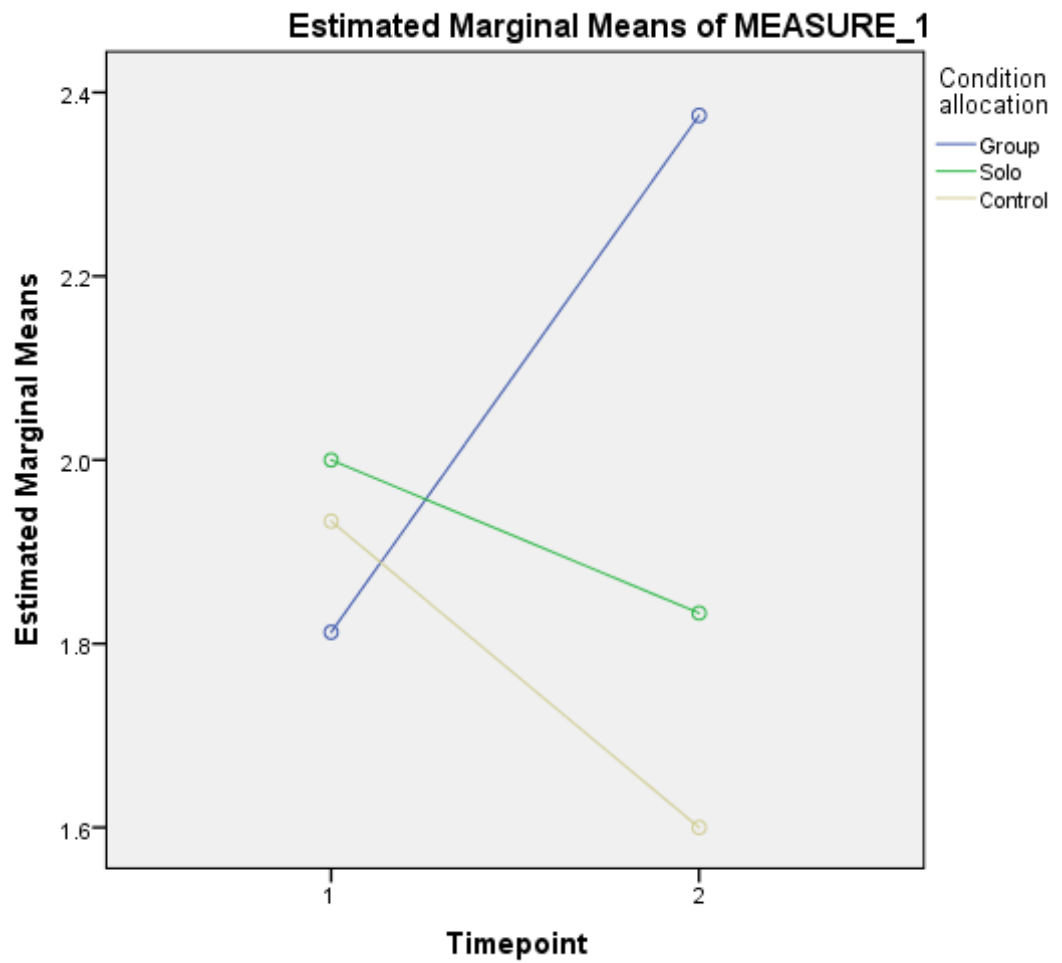


Figure N1. Interaction graph displaying the interaction between measurement time point (frequency of physical activity) and study condition (Study 1).

Time point 1 = initial measurement, time point 2 = week 8 measurement.

Appendix L₁ - Information sheet for group and solo study conditions (Study 2)

PARTICIPANT INFORMATION SHEET

Study Title: Eliciting positive behavioural change through self-efficacy as a consequence of social support experienced from computer-game play.

*I would like to invite you to take part in a research study. Before you decide I would like you to understand why the research is being done and what it would involve for you. **I will go through the information sheet with you and answer any questions you have.** This should take about 5 minutes. Talk to others about the study if you wish. Please ask if there is anything that is not clear.*

A large focus of today's health research revolves around lifestyle habits and behaviours of individuals and how we might modify these using technologies in order to encourage positive health-related behavioural change. It is thought that the concepts of social support and self-efficacy are significant in facilitating such behavioural change therefore, it is important to determine to what extent technologies such as computer-games may impact these.

What is the purpose of the study?

This study wants to find out about how computer games may facilitate social support and self-efficacy in individuals.

Why have I been invited?

You have been invited to take part because you have volunteered to participate.

Do I have to take part?

It is up to you to decide to join the study. I will describe the study and go through this information sheet. If you agree to take part, I will then ask you to sign a consent form. You are free to withdraw from the study at any time and can ask for your data to be destroyed up until (01/08/2017) without giving a reason.

What will happen to me if I take part?

After reading this document you will be asked to sign a consent form, this indicates that you are giving your fully-informed consent to participate in the study and that you acknowledge that you are aware of your rights as a participant in Psychological research.

Once this is done you will be given a participant demography questionnaire to complete, this will simply record your age and gender. You will also be asked to complete a Short Form Social Support Questionnaire, a General Self-Efficacy Scale and a Perceived Stress Scale.

Once you have completed these, you will be asked to engage with the computer-game Wii Sports for 30 minutes, instructions for how to play this game can be found in the standardised instructions document that you will also be given.

Once computer game play - has finished you will be asked to complete a second Short Form Social Support Questionnaire, General Self-Efficacy Scale and Perceived Stress Scale.

Once these have all been completed the experiment will end. However, due to the nature of this research being longitudinal **you will be required to return to the laboratory once on a weekly basis** to engage in the computer game and to complete subsequent administrations of the Short Form Social Support Questionnaire, the General Self-Efficacy Scale and the Perceived Stress Scale for **8 weeks** (from now on you will only need to complete these after each game play session). The experimenter will arrange these appointments with you at the end of each week's experiment.

It is possible that you may be asked to participate in a follow-up measurement 2 months after your participation in this research. This is entirely voluntary and will only require the completion of 3 questionnaires.

What are the potential disadvantages and risks of taking part in this study?

It is expected that there are no risks or disadvantages to participating within this study.

What are the possible benefits of taking part?

It is hoped that this study will help to provide further insight into the use of computer-games in facilitating social support and self-efficacy in their users furthermore, it is hoped that such changes will help to promote positive health-related behavioural changes e.g. reducing perceived stress.

What if there is a problem?

Any complaint about the way you have been dealt with during the study or any possible harm you might suffer will be addressed. If you have a concern about any aspect of this study, you should ask to speak to my Research Supervisor, Katherine Swainston who will do their best to answer your questions (contact details can be found below).

Will my taking part in the study be kept confidential?

Yes. I will follow ethical and legal practice and all information about you will be handled in confidence. All information which is collected about you during the course of the research will be kept strictly confidential, and any information about you will have your name and contact details removed so that you cannot be recognised.

What will happen to the results of the research study?

The data gathered during this study will be used for the purpose of contributing to the completion of a PhD. Additionally, when appropriate the data may be used within articles that will be published within scientific journals.

Who has reviewed the study?

Teesside University's ethics committee has reviewed and approved this study to be carried out, consequently it has been deemed to be safe and ethically sound for all individuals whom will be involved.

Contact for Further Information

Researcher: Jonathan Farnell J.Farnell@tees.ac.uk

Research supervisor: Katherine Swainston K.Swainston@tees.ac.uk

Appendix L₂ - Information sheet for control study condition (Study 2)

PARTICIPANT INFORMATION SHEET

Study Title: Eliciting positive behavioural change through self-efficacy as a consequence of social support experienced from computer-game play.

*I would like to invite you to take part in a research study. Before you decide I would like you to understand why the research is being done and what it would involve for you. **I will go through the information sheet with you and answer any questions you have.** This should take about 5 minutes. Talk to others about the study if you wish. Please ask if there is anything that is not clear.*

A large focus of today's health research revolves around lifestyle habits and behaviours of individuals and how we might modify these to encourage positive health related behavioural change. It is thought that the concepts of social support and self-efficacy are significant in facilitating such behavioural change. As a result of this it is important to measure these behaviours and lifestyles as well as social support and self-efficacy in order to gain a more in-depth understanding of them.

What is the purpose of the study?

This study wants to find out about people's behaviours and lifestyle choices in relation to their perceived stress.

Why have I been invited?

You have been invited to take part because you have volunteered to participate.

Do I have to take part?

It is up to you to decide to join the study. I will describe the study and go through this information sheet. If you agree to take part, I will then ask you to sign a consent form. You are free to withdraw from the study at any time and can ask for your data to be destroyed up until (01/08/2017) without giving a reason.

What will happen to me if I take part?

After reading this document you will be asked to sign a consent form, this indicates that you are giving your fully-informed consent to participate in the study and that you acknowledge that you are aware of your rights as a participant in Psychological research.

Once this is done you will be given a participant demography questionnaire to complete, this will simply record your age and gender.

Next you will be asked to complete a Short Form Social Support Questionnaire, a General Self-Efficacy Scale and a Perceived Stress Scale.

Once these have all been completed the experiment will end. However, due to the nature of this research being longitudinal **you will be required to return to the laboratory once on a weekly basis** to complete subsequent administrations of the Short Form Social Support Questionnaire and the Exercise Confidence Survey for **8 weeks**. The experimenter will arrange these appointments with you at the end of each week's experiment.

It is possible that you may be asked to participate in a follow-up measurement 2 months after your participation in this research. This is entirely voluntary and will only require the completion of 3 questionnaires.

What are the potential disadvantages and risks of taking part in this study?

It is expected that there are no risks or disadvantages to participating within this study.

What are the possible benefits of taking part?

It is hoped that this study will help to provide a representative insight into the general population's levels of perceived stress. It is also hoped that the study will help to identify facilitators and barriers in reducing it through social support and/or self-efficacy.

What if there is a problem?

Any complaint about the way you have been dealt with during the study or any possible harm you might suffer will be addressed. If you have a concern about any aspect of this study, you should ask to speak to my Research Supervisor, Katherine Swainston who will do their best to answer your questions (contact details can be found below).

Will my taking part in the study be kept confidential?

Yes. I will follow ethical and legal practice and all information about you will be handled in confidence. All information which is collected about you during the course of the research will be kept strictly confidential, and any information about you will have your name and contact details removed so that you cannot be recognised.

What will happen to the results of the research study?

The data gathered during this study will be used for the purpose of contributing to the completion of a PhD. Additionally, when appropriate the data may be used within articles that will be published within scientific journals.

Who has reviewed the study?

Teesside University's ethics committee has reviewed and approved this study to be carried out, consequently it has been deemed to be safe and ethically sound for all individuals whom will be involved.

Contact for Further Information

Researcher: Jonathan Farnell J.Farnell@tees.ac.uk
 Research supervisor: Katherine Swainston K.Swainston@tees.ac.uk

Version I – 11/04/2016

Thank you for reading this information sheet.

Appendix M - Consent form (Study 2)

Participant number:

Version I - 11/04/2016

CONSENT FORM

Title of project: Eliciting positive behavioural change through self-efficacy as a consequence of social support experienced from computer-game play

Researcher: Jonathan Farnell

Thank you for agreeing to take part in this research. In agreeing to participate you have the following rights and protections as laid down in the British Psychological Society's ethical guidelines.

- Your participation is entirely voluntary
- Under no circumstances will your real names or identifying information be included in the reporting of this research.
- You may withdraw your data from this research at any point until 01/08/2017
- Nobody, except myself and my research supervisory team will have access to this anonymised material in its entirety.

In agreeing to the terms of this consent form, participants should be aware that any anonymised material is solely for use in the current research project.

Please initial

I confirm that I have read and understood the participant information sheet datedversion (I) for the above study. I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily.

☐

I understand that my participation is voluntary and that I am free to withdraw at any time up until 01/08/2017, without giving any reason. To withdraw your data please contact the researcher at: J.Farnell@tees.ac.uk and state your participation number

☐

I agree to take part in the above study.

☐

Name of Participant

Date

Signature

Jonathan Farnell

Researcher

Date

Signature

1 for participant; 1 for researcher

Appendix N - Participant debrief (Study 2)

Date:

Version I - 11/04/2016

DEBRIEF

Title: Eliciting positive behavioural change through self-efficacy as a consequence of social support experienced from computer-game play

Researcher: Jonathan Farnell

Aim of research: This research is aiming to test if computer-games can be used to encourage health-related positive behavioural change in individuals. Specifically it is hoping to achieve this through using computer-games as a focal point of community between groups of people, it is predicted that members of such a group will experience enhanced social support and self-efficacy as a direct result of communal computer-game play. Theoretical evidence suggests that social support and self-efficacy are significant contributors to successful health-related behavioural change in humans.

I would like to emphasise that all information provided by yourself will be treated with strict confidentiality and under no circumstances will your name or any identifying characteristics be included in any subsequent reports or publications. If you have any further questions about this study I would be more than happy to assist and can be contacted via e-mail at:

J.Farnell@tees.ac.uk

Alternatively, my supervisor Katherine Swainston can be contacted via e-mail at:

K.Swainston@tees.ac.uk

You can withdraw your data from this study without giving a reason up until 01/08/2016 by contacting the researcher via the email address given above and quoting your participant number.

Follow-up data is hoped to be collected, you may be contacted in 2 months' time to voluntarily complete an additional series of questionnaires which can be done so electronically over email without laboratory attendance.

If you require further information about the health impact of exposure to stress and what benefits that you might expect from reducing it, the NHS Choices website family contains a lot of useful information:

<http://www.nhs.uk/conditions/stress-anxiety-depression/Pages/low-mood-stress-anxiety.aspx>

<http://www.nhs.uk/conditions/stress-anxiety-depression/pages/understanding-stress.aspx>

Thank you for your participation

Appendix O - Participant demographic questionnaire (Study 2)

Date: _____

Participant number: _____

Demography questionnaire

Please answer the following questions:

1). Are you Male or Female? MALE FEMALE

2). How old are you? _____

3). Can you describe below what your typical activities are for relieving stress?

Appendix P – (GSES) General Self-Efficacy Scale (Study 2)

Date: _____

Participant number: _____

Administration point: _____

General Self-Efficacy Scale

Below is a series of statements relating to overcoming problems in day-to-day life, please rate how accurately these statements describe you by using the scale which ranges from not at all true (1) to exactly true (4).

		Not at all true	Barely true	Moderately true	Exactly true
1.	I can always manage to solve difficult problems if I try hard enough.	1	2	3	4
2.	If someone opposes me, I can find means and ways to get what I want.	1	2	3	4
3.	It is difficult for me to stick to my aims and accomplish my goals.	1	2	3	4
4.	Thanks to my resourcefulness, I know how to handle unforeseen situations.	1	2	3	4
5.	I can solve most problems if I invest the necessary effort.	1	2	3	4
6.	I can remain calm when facing difficulties because I can rely on my coping abilities.	1	2	3	4
7.	I am not very confident that I could deal efficiently with unexpected events.	1	2	3	4
8.	When I am confronted with a problem, I can usually find several solutions.	1	2	3	4
9.	If I am in a bind, I can usually think of something to do.	1	2	3	4
10.	No matter what comes my way, I'm usually able to handle it.	1	2	3	4

Appendix Q – (PSS) Perceived Stress Scale (Study 2)

Date: _____

Participant number: _____

Administration point: _____

Perceived Stress Scale

The questions in this scale ask you about your feelings and thoughts during the last month. In each case, you will be asked to indicate how often you felt or thought a certain way. Although some of the questions are similar, there are differences between them and you should treat each as a separate question. The best approach is to answer each question fairly quickly. That is, don't try to count up the number of times you felt a particular way but rather indicate the option that seems like a reasonable estimate.

For each question choose from the following options:

Never	Almost never	Sometimes	Fairly often	Very often
0	1	2	3	4

1. In the last month, how often have you been upset because of something that happened unexpectedly?

2. In the last month, how often have you felt that you were unable to control the important things in your life?

3. In the last month, how often have you felt nervous and stressed?

4. In the last month, how often have you dealt with irritating life hassles?

5. In the last month, how often have you felt that you were effectively coping with important changes that were occurring in your life?

6. In the last month, how often have you felt confident about your ability to handle your personal problems?

7. In the last month, how often have you felt that things were going your way?

8. In the last month, how often have you found that you could not cope with all the things that you had to do?

9. In the last month, how often have you been able to control irritations in your life?

10. In the last month, how often have you felt that you were on top of things?

11. In the last month, how often have you been angered because of things that happened that were outside of your control?

12. In the last month, how often have you found yourself thinking about things that you have to accomplish?

13. In the last month, how often have you been able to control the way you spend your time?

14. In the last month, how often have you felt difficulties were piling up so high that you could not overcome them?

Appendix R - Sampling distribution of F_{max} table and the interpolation equation used to calculate variance ratio critical values for $df = 21, 22, 31,$ and 32 (Study 2)

Table R1

Sampling distribution of F_{max} table (Kanji, 1993).

Level of significance $\alpha = 0.05$

n - 1	k										
	2	3	4	5	6	7	8	9	10	11	12
2	39.0	87.5	142	202	266	333	403	475	550	626	704
3	15.4	27.8	39.2	50.7	62.0	72.9	83.5	93.9	104	114	124
4	9.6	15.5	20.6	25.2	29.5	33.6	37.5	41.1	44.6	48.0	51.4
5	7.15	10.8	13.7	16.3	18.7	20.8	22.9	24.7	26.5	28.2	29.9
6	5.82	8.38	10.4	12.1	13.7	15.0	16.3	17.5	18.6	19.7	20.7
7	4.99	6.94	8.44	9.70	10.8	11.8	12.7	13.5	14.3	15.1	15.8
8	4.43	6.00	7.18	8.12	9.03	9.78	10.5	11.1	11.7	12.2	12.7
9	4.03	5.34	6.31	7.11	7.80	8.41	8.95	9.45	9.91	10.3	10.7
10	3.72	4.85	5.67	6.34	6.92	7.42	7.87	8.28	8.66	9.01	9.34
12	3.28	4.16	4.79	5.30	5.72	6.09	6.42	6.72	7.00	7.25	7.48
15	2.86	3.54	4.01	4.37	4.68	4.95	5.19	5.40	5.59	5.77	5.93
20	2.46	2.95	3.29	3.54	3.76	3.94	4.10	4.24	4.37	4.49	4.59
30	2.07	2.40	2.61	2.78	2.91	3.02	3.12	3.21	3.29	3.36	3.39
60	1.67	1.85	1.96	2.04	2.11	2.17	2.22	2.26	2.30	2.33	2.36
∞	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

$$lower_{F_{max}} + \left[\left(\frac{actual_{df} - lower_{df}}{upper_{df} - lower_{df}} \right) \times (upper_{F_{max}} - lower_{F_{max}}) \right]$$

Figure R1. Equation for interpolating between known values of the sampling distribution of F_{max} table

$$2.95 + \left[\left(\frac{21 - 20}{30 - 20} \right) \times (2.40 - 2.95) \right] = 2.895$$

Figure R2. Equation example used to interpolate for a degrees of freedom value ($n-1$) of 21.

Table R2

Values needed to linearly interpolate Hartley's F_{max} variance ratio critical values ($k = 3$) for each df value included for inferential analysis in Study 1.

Actual df	Lower df	Upper df	Lower F_{max}	Upper F_{max}	Critical value
21	20	30	2.95	2.40	2.90
22	20	30	2.95	2.40	2.84
31	30	60	2.40	1.85	2.38
32	30	60	2.40	1.85	2.36

Appendix S - Smallest worthwhile change for each MBI comparison (Study 2)

Table S1

Study 2 pooled SD and smallest worthwhile effect for mixed 3×2 ANOVA MBI comparisons

Outcome variable	Comparison	SD pooled	Smallest worthwhile effect (0.2 x SD pooled)
SSQN	Solo vs Control	1.586	0.317
	Group vs Solo	1.718	0.344
	Group vs Control	1.284	0.257
SSQS	Solo vs Control	0.747	0.149
	Group vs Solo	0.660	0.132
	Group vs Control	0.701	0.140
GSES	Solo vs Control	4.743	0.949
	Group vs Solo	3.842	0.768
	Group vs Control	4.781	0.956
PSS	Solo vs Control	8.619	1.724
	Group vs Solo	7.220	1.444
	Group vs Control	8.102	1.620

Note. SSQN = Social Support Questionnaire number score; SSQS = Social Support Questionnaire satisfaction score; GSES = General Self-Efficacy Scale; PSS = Perceived Stress Scale; dividers between outcome variables included for clarity.

Table S2

Study 2 pooled SD and smallest worthwhile effect for ANCOVA MBI comparisons

Outcome variable	Comparison	SD pooled	Smallest worthwhile effect (0.2 x SD pooled)
SSQN	Group vs Solo	1.718	0.344
	Group vs Control	1.284	0.257
SSQS	Group vs Solo	0.660	0.132
	Group vs Control	0.701	0.140
GSES	Group vs Solo	3.842	0.768
	Group vs Control	4.781	0.956
PSS	Group vs Solo	7.220	1.444
	Group vs Control	8.102	1.620

Note. SSQN = Social Support Questionnaire number score; SSQS = Social Support Questionnaire satisfaction score; GSES = General Self-Efficacy Scale; PSS = Perceived Stress Scale; dividers between outcome variables included for clarity.

Appendix T - Information sheet for participants (qualitative study)

PARTICIPANT INFORMATION SHEET

Study Title: Eliciting positive behavioural change through self-efficacy as a consequence of social support experienced from computer-game play.

*I would like to invite you to take part in a research study. Before you decide I would like you to understand why the research is being done and what it would involve for you. **I will go through the information sheet with you and answer any questions you have.** This should take about 5 minutes. Talk to others about the study if you wish. Please ask if there is anything that is not clear.*

A large focus of today's health research revolves around lifestyle habits and behaviours of individuals and how we might modify these using technologies in order to encourage positive health-related behavioural change. It is thought that the concepts of social support and self-efficacy are significant in facilitating such behavioural change therefore, it is important to determine to what extent technologies such as computer-games may impact these.

What is the purpose of the study?

This study wants to find out about how computer games may facilitate social support and self-efficacy in individuals.

Why have I been invited?

You have been invited to take part because you have volunteered to participate.

Do I have to take part?

It is up to you to decide to join the study. I will describe the study and go through this information sheet. If you agree to take part, I will then ask you to sign a consent form. You are free to withdraw from the study at any time and can ask for your data to be destroyed up until (30/11/2019) without giving a reason.

What will happen to me if I take part?

After reading this document you will be asked to sign a consent form, this indicates that you are giving your fully-informed consent to participate in the study and that you acknowledge that you are aware of your rights as a participant in Psychological research.

Once this is done you will be given a participant demography questionnaire to complete, this will simply record your age and gender. You will also be asked to complete a Short Form Social Support Questionnaire and the Exercise Confidence Survey.

Once you have completed these, you will be asked to engage with the computer game Wii Sports for 30 minutes, instructions for how to play this game can be found in the standardised instructions document that you have also been given.

Once computer game play has finished you will be asked to complete a second Short Form Social Support Questionnaire and Exercise Confidence Survey.

Once these have all been completed the experiment will end. However, due to the nature of this research being longitudinal **you will be required to return to the laboratory once on a weekly basis** to engage in the computer game and to complete subsequent administrations of the Short Form Social Support Questionnaire and the Exercise Confidence Survey for **3 weeks** (from now on

you will only need to complete these after each game play session). The experimenter will arrange these appointments with you at the end of each week's experiment.

Following completion of questionnaires each week you will be asked to participate within a small focus group. The purpose of which is to collect qualitative data regarding your feelings and thoughts on the computer game intervention. The focus group will only involve questions related to the concepts already asked about within the administered questionnaires and is entirely voluntary.

What are the potential disadvantages and risks of taking part in this study?

It is expected that there are no risks or disadvantages to participating within this study.

What are the possible benefits of taking part?

It is hoped that this study will help to provide further insight into the use of computer-games in facilitating social support and self-efficacy in their users furthermore, it is hoped that such changes will help to promote positive health-related behavioural changes e.g. increasing physical activity.

What if there is a problem?

Any complaint about the way you have been dealt with during the study or any possible harm you might suffer will be addressed. If you have a concern about any aspect of this study, you should ask to speak to my Research Supervisor, Katherine Swainston who will do their best to answer your questions (contact details can be found below).

Will my taking part in the study be kept confidential?

Yes. I will follow ethical and legal practice and all information about you will be handled in confidence. All information which is collected about you during the course of the research will be kept strictly confidential, and any information about you will have your name and contact details removed so that you cannot be recognised.

Personal data including special category data obtained for the purposes of this research project is processed lawfully in the necessary performance of scientific or historical research or for statistical purposes carried out in the public interest. Processing of personal data including special category data is proportionate to the aims pursued, respects the essence of data protection and provides suitable and specific measures to safeguard the rights and interests of the data subject in full compliance with the General Data Protection Regulation and the Data Protection Act 2018.

What will happen to the results of the research study?

The data gathered during this study will be used for the purpose of contributing to the completion of a PhD. Additionally, when appropriate the data may be used within articles that will be published within scientific journals.

Who has reviewed the study?

Teesside University's ethics committee has reviewed and approved this study to be carried out, consequently it has been deemed to be safe and ethically sound for all individuals whom will be involved.

Contact for Further Information

Researcher:	Jonathan Farnell	J.Farnell@tees.ac.uk
Research supervisor:	Katherine Swainston	K.Swainston@tees.ac.uk

Appendix U – Focus group schedule for week 1 with group study condition

Focus group - week 1 - group study condition

Remember to label the session number on the digital audio file following recording of the focus group as well as on any notes or other materials generated during the course of the focus group.

Questions are in **bold** and potential follow-up questions to extract further information are indented below the primary question. Potential prompts can be found within parentheses.

Prior to beginning the focus group, ensure that participants have no objections to the use of the audio recorder then switch it on when ready to begin.

Introduction to the focus group

Give a general introduction to the focus group and answer any questions that participants may have regarding the focus group.

“I have some general questions regarding your thoughts and experiences about today’s computer game play.”

The focus group

1. Was the computer game enjoyable?

- What made it enjoyable?
- What made it not enjoyable?

2. Was the computer game beneficial?

- If so, in what way?

3. Did you find yourselves interacting with each other during computer game play? (You can answer in terms of in real-life or within the computer game itself)

- How did interaction occur?
- What was the purpose of the interaction?

4. Did socialisation enhance or detract from your computer game play experience? (If the computer game play was sociable, do you feel this added to the game play experience?)

- In what way did sociable game play improve/worsen the experience?

- Would playing individually have been preferable or more enjoyable?

5. Would computer game play with other people be more enjoyable in person or online? (The internet can be used to play computer games with people across the globe, do you feel that it would be more enjoyable to play this way or with people in the same room?)

- What effects enjoyment of co-located game play in comparison to non-co-located game play?

6. Did the computer game play affect your stress levels in any way?

- If it did. in which direction? (Did it make you feel more or less stressed?)

7. Are there any closing comments or thoughts to add?

Ending the focus group

Indicate to the participants that the focus group has ended and thank them for their time.

Turn off the audio recording device.

Appendix V – Interview schedule for week 1 with solo study condition

Interview - week 1 - solo study condition

Remember to label the session number on the digital audio file following recording of the interview as well as on any notes or other materials generated during the course of the interview.

Questions are in **bold** and potential follow-up questions to extract further information are indented below the primary question. Potential prompts can be found within parentheses.

Prior to beginning the interview, ensure that the participant has no objections to the use of the audio recorder then switch it on when ready to begin.

Introduction to the interview

Give a general introduction to the interview and answer any questions that the participant may have regarding the interview.

“I have some general questions regarding your thoughts and experiences about today’s computer game play.”

The interview

1. Was the computer game enjoyable?

- What made it enjoyable?
- What made it not enjoyable?

2. Was the computer game beneficial?

- If so, in what way?

3. How did you find yourself engaging with the computer game today? (How did you choose to spend your 30 minutes of computer game play time?)

- Did you have a preference between the three available activities?
- Did you decide to replay an activity or switch between them? Why?

4. Was playing the computer game by yourself an enjoyable experience?

(Did you enjoy playing the computer game by yourself?)

- What strategies did you use to make the game entertaining?

5. Given the opportunity to play with others, would the computer game have been more/less enjoyable? (Do you feel that playing this computer game with other people would have been more/less enjoyable?)

- What would this change in terms of enjoyment for you?
- Do you feel that this would be a meaningful experience?
- If playing with others, would you have any preference in playing with people in the same room or online instead?

6. Did the computer game play affect your stress levels in any way?

- If it did, in which direction? (Did it make you feel more or less stressed?)

7. Are there any closing comments or thoughts to add?

Ending the interview

Indicate to the participant that the interview has ended and thank them for their time.

Turn off the audio recording device.

Appendix W – Focus group questions for weeks 2 and 3 with group study condition

The focus groups conducted at weeks 2 and 3 followed the same general format as that described within the Focus group schedule for week 1 (Appendix U), in which the below questions were asked. Prompts as well as follow-up questions are presented and indented underneath each question.

Week 2 focus group questions

1. How did you find your computer game play this week?
 - Easier / harder?
 - More fun / less fun?
 - More engaging / less engaging?

2. Which computer game activities did you play?
 - Did you play any new activities this week?
 - Did you repeat any activities from last week?

3. Last week some of you suggested that the computer game play was more fun due to playing it multiplayer. Do you feel that this is still the case?
 - Follow-up question: What in particular about the multiplayer game play made it appealing/not appealing?

4. In what way did you find yourselves interacting with each other?
 - Competitively or collaboratively?
 - Interacting in the real world, for example taunting or encouraging?
 - Follow-up question: Was this interaction meaningful in any way?

5. Looking forward to your final week of participation, how do you expect you might engage with the computer game?
 - Trying new game activity modes or playing ones that you have already tried?

6. Thinking back to your levels of stress last week, do you now feel more or less stressed in comparison?
 - Follow-up question: (If changed) Do you feel that this change could be attributable to the computer game play session(s)?

7. Do you have any general closing comments or thoughts regarding today's computer game play?

Week 3 focus group questions

1. This was the final week of computer game play. How did you find the computer game this week?
 - Which games did you play? A new one or same ones from previous week(s)?
 - Follow-up question: Did you find the computer game play to be easier / harder, more fun / less fun, more engaging / less engaging?
2. The past two weeks some of you suggested that you were instructing each other on the computer game's controls and some techniques to play more effectively. Was this still occurring today?
3. Thinking over today's and the previous sessions of computer game play, what do you feel was the most enjoyable part of it?
 - That is, if you had a most enjoyable part.
4. On the other hand, what do you feel was the least enjoyable part of it?
 - That is, if you had a least enjoyable part.
5. Last week you indicated that you probably would not find yourselves playing this particular computer game on your own. Is this still the case?
 - Why would you not enjoy playing this computer game on your own?
6. Comparatively to the start of the study two weeks ago, do you think you feel less or more stressed now, or the same?
7. Do you have any closing comments or thoughts about the study as a whole?

Appendix X – Interview questions for weeks 2 and 3 with solo study condition

The semi-structured interviews conducted at weeks 2 and 3 followed the same general format as that described within the interview schedule for week 1 (Appendix V), in which the below questions were asked. Prompts as well as follow-up questions are presented and indented underneath each question.

Week 2 interview questions (solo participant #1)

1. How did you find your computer game play this week?
 - Easier / harder?
 - More fun / less fun?
 - More engaging / less engaging?
2. Which computer game activities did you play?
 - Did you play any new activities this week?
 - Did you repeat any activities from last week?
3. You indicated in last week's interview that the computer game might have been more fun to play multiplayer with other people. Do you still feel that this is the case?
 - Follow-up question: (If yes) what do you feel would be different then if you were playing with other people?
4. If you were participating with other people in this study and playing the computer game with them each week, do you feel like the computer game play sessions would be beneficial in any way to you?
5. Another topic that you spoke about in last week's interview was that of repeating the same game activities in order to improve your ability and score. Did you find yourself developing any additional techniques today to improve your game play?
 - Alternatively, were you simply refining skills that you learnt in last week's game play session?
6. Do you feel that this motivation to improve your scores and ability within the computer game will continue to engage you in next week's session?
7. Do you feel that if you were playing the computer game with other people that this would provide better opportunities for you to improve your computer game play abilities?

8. Do you find that you're less stressed today following your computer game play than you were at the start of the study last week?

- Follow-up question: (If changed) Do you feel that this change could be attributable to the computer game play session(s)?

9. Next week is the final week of the study, are you hoping to see more gradual improvements in your computer game performance next week?

10. Do you have any general closing comments or thoughts regarding today's computer game play?

Week 3 interview questions (solo participant #1)

1. How did you find your computer game play this week?

- Easier / harder?
- More fun / less fun?
- More engaging / less engaging?

2. In our interviews over the previous two weeks you have indicated that you enjoyed playing the computer game by competing with yourself and finding new techniques to beat your own scores. Do you feel that has been a rewarding endeavour in general?

- Follow-up question: In thinking about this goal of yours, the improvement of your performance, is there anything that might have enhanced this objective?

3. Thinking over today's, and the previous sessions of computer game play, what do you feel was the most enjoyable part of it?

- That is, if you had a most enjoyable part.

4. On the other hand, what do you feel was the least enjoyable part of it?

- That is, if you had a least enjoyable part.

5. Given the opportunity to do so you previously indicated a preference for playing this computer game alongside other people. Do you still feel this to be the case?

6. Follow-up question: Do you feel that playing this computer game with other people, perhaps strangers, over the past few weeks would have been an enjoyable experience?

- Follow-up question: Do you believe that playing with others would have been beneficial to you in any way?

6. How would you describe your levels of stress today?

7. Thinking back over the past three weeks, do you feel the same level of stress now than before or has it changed?

- Follow-up question: (If changed) Do you feel that this change could be attributable to the computer game play session(s)?

8. Do you have any closing comments or thoughts about the study as a whole?

Week 2 interview questions (solo participant #2)

1. How did you find your computer game play this week?
 - Easier / harder?
 - More fun / less fun?
 - More engaging / less engaging?
2. Which computer game activities did you play?
 - Did you play any new activities this week?
 - Did you repeat any activities from last week?
3. You indicated in last week's interview that the computer game might have been more fun to play multiplayer with other people. Do you still feel that this is the case?
 - Follow-up question: (If yes) what do you feel would be different then if you were playing with other people?
4. If you were participating with other people in this study and playing the computer game with them each week, do you feel like the computer game play sessions would be beneficial in any way to you?
5. In last week's interview you indicated that you enjoyed playing the same computer game activity (bowling) for the allotted time in order to better your score and improve at the game. Did you find yourself doing something similar today?
 - Did you apply skills that you learnt in the previous game play session to your game play today?
6. In last week's interview you indicated that you perhaps felt a bit less stressed following the computer game play session. How are you feeling today in terms of your stress levels?
 - Follow-up question: (If changed) Do you feel that this change could be attributable to the computer game play session(s)?
7. Do you have any general closing comments or thoughts regarding today's computer game play?

Week 3 interview questions (solo participant #2)

1. How did you find your computer game play this week?
 - Easier / harder?
 - More fun / less fun?
 - More engaging / less engaging?

2. Which computer game activities did you play?
 - Did you play any new activities this week?
 - Did you repeat any activities from last week?

3. Thinking over today's, and the previous sessions of computer game play, what do you feel was the most enjoyable part of it?
 - That is, if you had a most enjoyable part.

4. On the other hand, what do you feel was the least enjoyable part of it?
 - That is, if you had a least enjoyable part.

5. In the previous interviews you have indicated that given the opportunity to do so, you would have preferred playing this computer game with other people. Is that still the case?

6. Follow-up question: Do you feel that playing this computer game with other people, perhaps strangers, over the past few weeks would have been an enjoyable experience?
 - Follow-up question: Do you believe that playing with others would have been beneficial or meaningful to you in any way?

7. Last week you talked about finding the computer game to be less enjoyable as it didn't distract you from your thoughts and troubles. Did you find that happening again today?
 - Follow-up question: Had you been playing the computer game with other people, do you feel that this would help to prevent you from dwelling on your troubles?

8. In terms of your stress levels, how are you feeling today following your computer game play?
 - Follow-up question: In comparison to the first week of this study do you feel more or less stressed, or the same?
 - Follow-up question: (If changed) Do you feel that this change could be attributable to the computer game play session(s)?

9. Do you have any closing comments or thoughts about the study as a whole?

Appendix Y – Poster presented at the 11th annual Midlands Health Psychology Network conference, February 2015

Increasing physical activity through self-efficacy as a consequence of social support experienced from computer game interaction

Jonathan Farnell, Dr. Katherine Swainston, Professor Paul Van Schaik, & Dr. Amanda McNamee

Teesside University

1. Introduction

The present study is interested in (1) the efficacy of computer games in eliciting positive behavioural change and (2) the mechanisms of how this occurs.

A mediational relationship was proposed (see Fig 1.) postulating that an increase in social support derived from computer game play (Stenros, Paavilainen, & Mäyrä, 2009 and leisure coping theory [Iwasaki & Mannell, 2000]) will contribute to increased self-efficacy (Berkman, 1995; Resnick, Orwig, Magaziner, & Wynne, 2002) which in turn, facilitate positive behavioural change.

The following hypotheses have been formulated:

- H₁: Group participants will experience a statistically significant increase of social support, self-efficacy and physical activity.
- H₂: Solo and control participants will not experience a statistically significant increase of social support, self-efficacy or physical activity.
- H₃: A mediational relationship will be present in the group condition between social support and physical activity with self-efficacy acting as the mediator.

2. Method

Design

An Independent measures quasi-experimental design was used.

IV: Participant condition with 3 levels group, solo and control.

DV₁: Social support

DV₂: Self-efficacy

DV₃: Weekly physical activity

Participants

Prospective power analysis for large effect size $n = 21$, accounting for attrition $N = 72$.

Participants were Teesside University undergraduate Social Sciences students.

A self-selected sampling strategy was used.

Materials

Social support and self-efficacy were recorded using the following measures respectively.

The Short Form Social Support Questionnaire (SSQ6)

The Self-Efficacy and Exercise Habits Survey (SEEHs)

Weekly physical activity was measured through self-report.

Procedure

Group condition consisted of 3 or 4 participants and solo condition recruited individuals. Group and solo participants exposed to 30 minutes of Nintendo Wii Sports gameplay Tennis, bowling or golf.

Participants attended weekly laboratory sessions to complete measures (post gameplay for group and solo participants).

Fig 1.

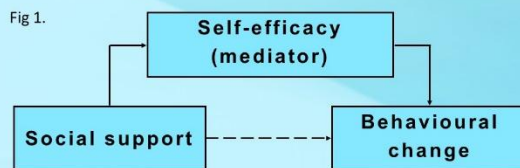


Fig 2.



Fig 3.



Fig 4.



Fig 5.

Fig 1. A diagram of the proposed model of mediation between social support (IV), self-efficacy (mediator) and increasing physical activity (DV) – the behavioural change under investigation.

Fig 2. A photograph of the laboratory setup that was used.

Fig 3-5. Screenshots from the Nintendo Wii Sports computer game depicting the games that participants engaged with; Bowling (fig 3.), Tennis (fig 4.) and Golf (fig 5.).

3. Current progress & expected results

A successful pilot study involving 4 participants over a 2 week period was conducted which yielded feedback which was used to inform various changes to the study's design. Examples include: ensuring participant confidentiality through modifying the response format for the SSQ6 and optimizing the laboratory equipment layout.

Presently 11 participants (4 group, 1 solo and 6 control) have been recruited into the study at this time, with 10 participants having completed the experiment. Further participant recruitment is ongoing.

Data analysis is expected to involve analysis of covariance (ANCOVA) techniques to look for significant changes in social support, self-efficacy and physical activity (H₁ & H₂). Mediation analysis will be used to test for the postulated mediating relationship (H₃).

Group condition:

It is expected that significant increases in social support, self-efficacy and physical activity will occur during the course of the experiment and that a mediating relationship will be detected between these variables.

Solo & control conditions:

It is expected that there will be no significant changes over the course of the experiment in social support, self-efficacy or physical activity.

The purpose of the solo condition was to provide evidence to show that it was not the playing of the computer game that provided social support but the social experiences made possible through computer game gameplay (what the group condition experiences) that does.

4. Conclusions

Why is this research important?

It is expected that findings of this investigation will produce valuable insights into the mechanisms of how positive behavioural change occurs.

Additionally, it is expected that a better understanding of the role of computer games in health psychology research will be gained as well as showcasing the potential health outcomes that can be gained from their use.

Future research

This study represents the first in a series of investigations that will be focusing on 3 different highly significant health related behaviours which are; increasing physical activity, weight loss and stress relief. The purpose of this is to show that it can be applied to numerous circumstances of behavioural change thus, lending credibility to the model.

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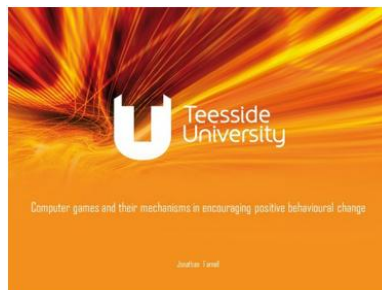
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Appendix Z – Presentation given at the Teesside University Psychology Conference, February 2015



Slide 1 - Title

My research (1)

What am I investigating?

- 1: Computer games encouraging positive behavioural change
 - Increasing physical activity
 - Weight loss
 - Stress relief
- What is positive behavioural change?
 - Theory of changing negative behaviours to beneficial ones
 - Examples: Quitting smoking, dieting etc.
- Why is it important?
 - Negative health behaviours costly on healthcare
 - Associated health concerns

Slide 2 – My research (1)

My research (2)

- 2: Investigating the mechanisms of this relationship
- Social support
 - Generates coping resources from social relationships (Cohen & Hobermann, 1983).
 - Gained from computer games (Longman, O'Connor, & Obat, 2009); Stearns, Paavilainen, & Meyer, 2009).
- Self-efficacy
 - An individual's belief in their own capabilities to act to achieve a desired outcome (Bandura, 1977).
 - Associated with higher levels of social support (Bandura, 1989; Resnick, Greig, Magister, & Wynne, 2002).
- My research proposes a mediating relationship, which is...

Slide 3 – My research (2)

What is mediation?

- Typically:

Cause	Effect
Social support (Independent variable - IV)	Increased physical activity (Dependent variable - DV)
- When a mediator is involved:

Social support (Independent variable - IV)	Self-efficacy (Mediator)	Increased physical activity (Dependent variable - DV)
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Slide 4 – What is mediation?

Methodology (1)

- Design
 - Independent measures quasi-experimental design
 - Participants arranged into 3 conditions: Group, solo or control
- Participants
 - Teesside University social sciences students
 - Self-selected sampling strategy
 - Hoping to recruit up to 72 participants per study

Slide 5 – Methodology (1)

Methodology (2)

- Materials
 - Short form social support questionnaire (Sutton, Smith, & Swettenham, 1987)
 - Self-efficacy and exercise habits survey (Sallis, Pate, Gossman, Patterson, & Fisher, 1988)
 - Self-reported weekly physical activity
- Procedure
 - Conducted over 8 weeks, with weekly sessions
 - 30 minutes of Wii Sports game for group/solo conditions
 - measures administered (post gameplay for group/solo)
- Data analysis
 - 216 pieces of data per participant
 - Analysis of co-variance testing intervention efficacy
 - Mediation analysis to test the mediating role of self-efficacy

Slide 6 – Methodology (2)

Methodology (3)

Slide 7 – Methodology (3)

What am I expecting to find?

- Group
 - It is expected that scores of social support will increase over the weeks of the study
 - As a direct result it is expected that scores of self-efficacy will increase
 - Causing reported weekly physical activity to also increase
- Solo
 - No significant change is expected to occur in the measured variables
 - Important to measure individuals to prove that it is not the game providing social support but rather social interaction
- Control
 - No significant change is expected to occur in the measured variables
 - Control data is valuable to measure as it can be used to explain and account for extraneous variables, e.g. Christmas

Slide 8 – What am I expecting to find?

Why is this important?

- When conducting research, it is important that it will contribute to existing knowledge and/or have practical applications.
- 1). This research will help to further understanding of behaviour change and its' mechanisms of action.
- 2). Mediation relationship will be tested across 3 highly significant health-related behaviours.
- 3). If the experiments yield significant findings then treatment strategies can be developed for clinical use.

Slide 9 – Why is this important?

Summary

- To summarise:
 - My research is interested in how computer games can encourage positive behavioural change
 - Strongly interested in the psychosocial mechanisms of such change
 - Testing using an 8 week independent measures quasi-experiment involving 3 groups of participants
 - Weekly interaction with Nintendo Wii Sports and measures
 - 2 additional experiments will be conducted
 - Findings may be unique contributions to existing knowledge
 - Practical real-world applications of the findings

Slide 10 - Summary

Any questions?

- Thank you for listening

Slide 11 – Any questions?

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Slide 12 - References



Slide 13 - End